THE

# AMERICAN CYCLOPÆDIA:

A

## Popular Dictionary

OF

# GENERAL KNOWLEDGE.

EDITED BY

GEORGE RIPLEY AND CHARLES A. DANA.

*WITH SUPPLEMENT.*

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# THE AMERICAN CYCLOPÆDIA.



**SHOMER, Jebel,** an inland division of Arabia, between lat. 25° 40′ and 32° N., and lon. 37° 20′ and 47° 20′ E., bounded N. by the Syrian desert, N. E. by Irak Arabi, S. E. and S. by the Wahabee sultanate, and W. by Turkish Arabia. It is divided into the provinces of Jebel Shomer, Jowf, Kheybar, Upper Kasim, and Teyma, with a total population estimated by Palgrave in 1862 at 440,000, including 166,000 nomadic Bedouins. Jebel Shomer in its general aspect is a flat table land, a large part of which is desert, with occasional oases. These are merely depressions in the desert surface, and take sometimes the form of a long valley covered with a thin soil, under which water may generally be found at the depth of a few feet. Fruits, bushes, herbs, and coarse grass grow in sufficient quantities to supply food for the Bedouins and their camels and flocks. The entire N. portion is covered by a rocky desert. On the E. border, about lat. 31°, is a long valley, called Wady Sirhan or Serhan (valley of the wolf), which extends from near Bozrah in Syria in a S. E. direction to about lat. 29° 20′ in Arabia, where its base rests on Wady Jowf, a deep valley lying E. and W., and which may be considered the porch or vestibule of central Arabia. (See Jowf.) The Wady Sirhan is the common route for caravans to and from Syria. S. and E. of Jowf lies a wide expanse of sandy desert. The caravan route to the province of Jebel Shomer lies across this waste in a S. E. direction through what is called the Nefud or Sand pass, consisting of parallel ridges of loose reddish sand 200 to 300 ft. high, where no water can be obtained for nearly 100 m. The route runs beside a small range of hills called Jebel Jobbah, a cluster of black granite rocks streaked with red, about 700 ft. high. Beyond them, on the south, is a barren plain, partly white and incrusted with salt, partly green and studded with palm groves, among which is the small village of Jobbah. From the heights overlooking Jobbah are visible in the southeast the main range of Jebel Shomer, and in the southwest the palm groves of Teyma, famed in Arab history, and supposed by some to be identical with the Teman of Scripture. Beyond Jobbah the undulations are not so deep, and the sand has occasional shrubs and tufts of grass. The plain gradually rises as it approaches the mountain ranges, which, stretching N. E. and S. W., cross two thirds of upper Arabia. These ranges, Jebel Adja on the north, the mountains of Upper Kasim on the south, and Jebel Solma between, lie nearly parallel, and are separated by broad plains covered with grass and shrubbery. Within their limits is the chief centre of population of Shomer. Hayel, the capital, lies in an extensive plain between Adja and Solma, girt on every side by a high mountain rampart. The only approach from the north is by a narrow winding defile through Jebel Adja, which 50 men could defend against thousands. The range of Jebel Adja, or Jebel Shomer as it is now more generally called, is a ragged granitic mass, piled up in fantastic disorder, attaining at times an elevation of 1,400 ft. above the plain, but Solma does not rise more than 700 or 800 ft. Good crops of grain, fruits, and vegetables are raised by a laborious system of artificial irrigation. The date is the principal fruit. There is a considerable trade by caravans between Hayel and Medina on the southwest, and Riyad, the capital of Nedjed, on the southeast. Many horses and asses are exported. Upper Kasim, the southernmost province of Shomer, is an elevated plateau, forming part of a long upland belt that crosses diagonally the northern half of the peninsula, one extremity reaching nearly to Zobeyr, near the head of the Persian gulf, and the other to the neighborhood of Medina. Its surface is covered with shrubs and brush-

wood, and in spring and summer with grass. This great plateau is intersected at intervals by long broad valleys, which contain villages built around wells, surrounded by palm groves, gardens, and fields, and varying in population from 500 to 3,000. Dates are exported in large quantities to Yemen and Hedjaz, and cotton is raised to a small extent.—The sultanate of Jebel Shomer originated in the present century. In 1818 Abdallah, an ambitious chief of the family Rashid, was driven out of Hayel by his rival Beyt Ali, who assumed the sovereignty. Abdallah took refuge at the court of the Wahabee monarch, who was then reconstructing his father's dominions, and for his services to him was made absolute governor of Shomer, with right of succession, and supplied with the means to establish his rule. Beyt Ali and his family were cut off, and Abdallah made himself master of the whole mountain district. He died about 1845, and was succeeded by his son Telal, who extended his dominions, subdued the Bedouins, invited trade from abroad, and established law and order. Under his rule the country has made rapid advances in civilization and prosperity, and has become virtually independent.

**SHOOTING STARS.** See METEOR.

**SHORE, Jane**, an English woman, the wife of Matthew or William Shore, a goldsmith in London, and mistress of King Edward IV. She was beautiful and amiable, and Sir Thomas More says that the king's favor "she never abused to any man's hurt, but to many a man's comfort and relief." After the death of the king she became attached to Lord Hastings; and when Richard III. had resolved on the destruction of that nobleman, he accused Jane Shore of witchcraft and of having withered his arm by sorcery. The king, though he sent her to prison and confiscated her goods, did not attempt to maintain his charge of witchcraft; but the bishop of London caused her to do public penance for impiety and adultery. After the death of Hastings, Thomas Lynom, the king's solicitor, desired to marry her, but was prevented by the king. She lived till the time of Henry VIII., and tradition represents her as dying of hunger in a ditch. A celebrated tragedy by Rowe is founded on her story.

**SHOSHONE**, the N. county of Idaho, bounded S. by the Clearwater river, and intersected in the north by Clarke's fork of the Columbia and the Kootenay river; area, about 12,000 sq. m.; pop. in 1870, 722, of whom 468 were Chinese. It is watered by tributaries of the Clearwater river and by the Spokane river, and contains Cœur d'Alène and Pend d'Oreille lakes. The surface is mountainous. There is fertile land around the lakes and along the streams. Timber is abundant, and there are extensive placer gold mines. Capital, Pierce City.

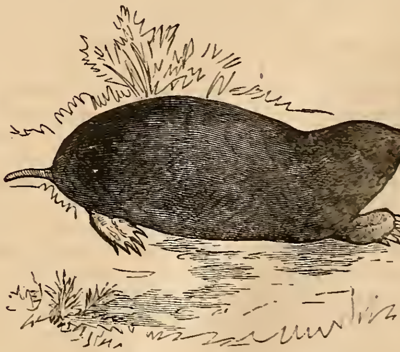
**SHOSHONES**, or **Snakes**, a family of North American Indians, embracing the Shoshones proper, the Utes, Comanches, Moquis, Chemehueves, Cahuillo, and the Kechi, Kizh, and Netela of California. The Shoshones proper are a large and widespread people. According to their tradition, they came from the south, and when met by Lewis and Clarke in 1805 they had been driven beyond the Rocky mountains. The various Shoshone bands have gone by numerous names. The most important were the Koolsatikara or Buffalo Eaters, who have long defended their homes on Wind river, and the Tookarika or Mountain Sheep Eaters, a fierce tribe in the Salmon river country and upper Snake river valley. The western Snakes near Fort Boisé were separated from the others by the kindred Bannacks. The Shoshocos (footmen), called also White Knives, from the fine white flint knives they formerly used, were digger tribes on Humboldt river and Goose creek, and included apparently most of those in the basin of Great Salt lake. These bands were generally mild and inoffensive, lurking in the mountains and barren parts, and having little intercourse with the whites. About 1849 they were in open war, and the peace made with some of the bands at Salt Lake, in September 1855, did not end it. In 1862 California volunteers, under Col. Connor, nearly exterminated the Hokandikah or Salt Lake Diggers in a battle on Bear river. Waushakee's and other bands of the Koolsatikara Shoshones made peace at Fort Bridger, July 2, 1863; Pokatello's and other bands of the Tookarika at Box Elder, July 30; the Shoshoco or Tosowitch at Ruby valley, Oct. 1; and the Shoshones and Bannacks at Soda Springs, Oct. 14. In 1864 the Yahooskin Snakes made peace, and with the Klamaths and Modocs ceded their lands; and on Aug. 12, 1865, the Wohlpapes also submitted. The government did not promptly carry out these treaties, and many of the bands renewed hostilities. In 1867, in the campaign of Gen. Steele, a number of Indians were killed, and immense stores of provisions laid up by the Shoshones were destroyed. Gen. Augur at last allowed them to come in and make peace at Fort Bridger. The government then attempted to collect the whole nation and restrict the Shoshone bands to certain reservations. The Yahooskin and Wohlpape Snakes had prospered on the Klamath reservation, although their crops frequently failed. The Fort Hall reservation in Idaho was begun in 1867 for the Bannacks, and several bands of Shoshones, about 1,200 in all. The Shoshone reservation in Wyoming, set apart under treaty of July 3, 1868, for Waushakee's and other bands of eastern Shoshones and Bannacks, is exposed to attacks from the Sioux, and only about 800 have united there. There are also the northwestern Shoshones in Nevada and Utah, estimated at from 2,000 to 3,000, and a band of 400 in the N. W. part of Idaho.—Vocabularies have been obtained from various bands of the Shoshones, but no critical study of their language has appeared. The Episcopalians have a mission on the reservation in Wyoming.

**SHOT.** See Lead, vol. x., p. 262.

**SHOVELLER.** See Duck, vol. vi., p. 289.

**SHREVEPORT,** a city and the capital of Caddo parish, Louisiana, in the N. W. corner of the state, on the W. bank of Red river, at the head of low-water navigation, 330 m. above its mouth according to Humphreys and Abbot, or 500 m. by local authorities; pop. in 1870, 4,607, of whom 2,168 were colored. It has since been enlarged, and the population in 1875 was locally estimated at 12,000. It contains many handsome residences and substantial business structures, is lighted with gas, and has a good fire department and several miles of street railroad. The principal public buildings are the new market, costing $50,000; the Presbyterian church, costing $35,000; and the synagogue, a fine specimen of architecture. The surrounding country is very productive, and the climate is mild and generally healthful. Shreveport is the E. terminus of the Texas and Pacific railroad, which affords an all-rail route to St. Louis *via* Marshall, Tex. Steamers run regularly to New Orleans and intermediate points on the Red and Mississippi rivers. The trade is extensive and increasing, the value of shipments amounting to about $7,500,000 a year, and the sales of merchandise to about $7,000,000. The shipments of cotton average 100,000 bales annually, including about 20,000 bales from the upper Red river reshipped at this point. The transactions in hides, wool, and tallow are also considerable. The principal manufactories are two of carriages, one each of cotton gins, cotton-seed oil, sash and blinds, and spokes and hubs, three founderies and machine shops, a planing mill, two saw mills, and three breweries. There are three private banks, two public schools (one for white and one for colored children), nine private and denominational schools and academies, two daily and weekly newspapers, and eleven churches (Baptist, Episcopal, Jewish, Methodist, Presbyterian, and Roman Catholic), of which five are for colored people. Shreveport was incorporated in 1839.

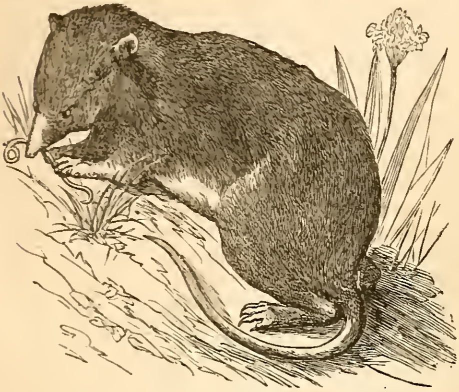
**SHREW, or Shrew Mouse,** the common name of the insectivorous mammals of the family *soricidæ*, characterized by a general rat-like or mouse-like appearance, elongated and pointed muzzle, and soft fur. The distinct auricle of the ears, and the normal size of the anterior feet, not usually employed in digging, distinguish them from the moles. The skull is long and narrow, compressed at the orbits, malar bone and zygomatic arch wanting; the ribs are 12 to 14 pairs, 6 to 8 vertebræ without ribs, 3 to 5 sacral, 14 to 28 caudal; tibia and fibula united, clavicles thin, and pubic arch closed; stomach simple; cæcum in some absent, in others very large; on the sides of the body, nearest the anterior limbs, and in some at the base of the tail, is a series of glands which secrete a strong musky fluid. The teeth vary from 28 to 32; there are two very large incisors in each jaw, nearly horizontal in the lower and much curved in the upper; canines absent; premolars $\frac{3-3}{2-2}$ to $\frac{4-4}{2-2}$, molars $\frac{3-3}{3-3}$; the posterior molars are many-pointed, and the anterior ones conical; the precise homologies of the cheek teeth have been the subject of much controversy. The snout ends in a naked muffle with the nostrils pierced on the sides; eyes very small, ears distinct, and feet nearly plantigrade and usually naked beneath; mammæ six to ten; feet five-toed, each with a claw. Their food consists of insects, worms, and mollusks, though they sometimes destroy small vertebrates and devour each other; they are nocturnal, more or less aquatic, do not hibernate, and the young are born blind and naked; most of the species live on the surface of the ground, and a few in burrows. They are spread over the northern hemisphere, sometimes going very far north, and the smaller species enduring severe cold. The subfamily *soricinæ* is the only one represented in North America; other subfamilies are found in south and central Africa, Asia, the East Indies, and Europe; none as yet have been detected in South America.—Of the American genera, *neosorex* (Baird) has rather short ears, partly furred on both surfaces; teeth 32; tail longer than body and head, and hairs of equal length except a tuft at the tip; feet very large, with a fringe of ciliated hairs; muzzle very slender. In the genus *sorex* (Linn.), which contains a great part of the species of the new and old worlds, the ears are large and valvular, the tail about as long as the body, and the feet moderate and not fringed; it is divided into two sections, one with 32 and the other with 30 teeth, most of the American species belonging in the former. Prof. Baird describes 12 species in vol. viii. of the Pacific railroad reports, varying in length from 3 to 4½ in., of which the tail is about one half, ranging from blackish and brownish to grayish above and lighter to whitish below. The *S. personatus* (Geoffr.) is the least of the American shrews, and among



Mole Shrew (Blarina talpoides).

the smallest of the quadrupeds of this country, being not quite 3 in. long; it belongs in the S. Atlantic states. Most of the species belong on the Pacific coast or in the N. W. territories.

In the genus *blarina* (Gray) the body is stout; the tail shorter than the head, with short bristly hairs and small brush at tip; the hands large in proportion to the feet, and the soles usually hairy at the heels; skull short and broad; ears very short, with the external surface densely furred. This genus, peculiar to America, is also divided into sections, one with 32, the other with 30 teeth. The mole shrew (*B. talpoides*, Gray), the largest of the American shrews, 4½ in. long, is found from Nova Scotia to Lake Superior, and south to Georgia; it is



Common European Shrew (Sorex araneus).

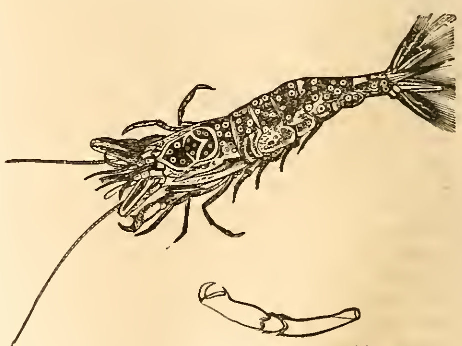
dark ashy gray above and paler below, with whitish feet. Several other species are described by Baird, of which two are in Mexico and Texas. In the old world, among the species of *sorex*, subdivided into several by Wagler, and called *musaraignes* by the French, is the common European shrew (*S. araneus*, Linn.), 4½ to 5 in. long, of which the tail is 1½ in.; the color is reddish mouse above and grayish below; it is found in dry places very generally over Europe.—The shrews appear during the miocene age in small numbers, and continue through the diluvial epoch to the present time, without material change.

**SHREW MOLE.** See MOLE.

**SHREWSBURY,** the shire town of Shropshire, England, on the river Severn, 140 m. N. W. of London; pop. in 1871, 23,406. The remains of the ancient castle are still standing, and also a portion of the ancient walls of the city. The Severn is crossed by two bridges; there is a canal, and railways connect it with all parts of the kingdom. Shrewsbury is the seat of a Roman Catholic bishop, and in 1872 had 32 places of worship. The principal manufactures consist of thread, linen yarn, and canvas; and there are extensive iron works at Coleham, a suburb. The salmon fishery of the Severn is valuable. There is a considerable trade in Welsh flannels.—Shrewsbury was important in the 5th century, and is prominent in English history as a royal residence for short periods. Its original name of Pengwern was changed by the Saxons to Scrobbesbyrig (Scrubsborough), of which Shrewsbury is a corruption. Parliaments were held here in 1283 and 1398; and a battle was fought here in 1403 between the royalist troops and the insurgents under Douglas and Hotspur, in which the latter was killed. (See PERCY.)

**SHRIKE.** See BUTCHER BIRD.

**SHRIMP,** a common decapod or ten-footed and long-tailed crustacean, of the genus *crangon* (Fabr.); with the prawn (*palæmon*) it is called *crevette* by the French. The integument is corneous, the carapace considerably flattened, the abdomen very large, and the tail powerful; the rostrum very short; eyes large and free; antennæ inserted about on the same transverse line, the internal pair the shortest and ending in two many-jointed filaments, the outer larger and longer; mandibles slender and without palpi; jaw feet moderate, with a terminal flattened joint and a short palpus on the inside; sternum very wide behind; first pair of feet strong, ending in a flattened hand having a movable hook opposed to an immovable tooth; second and third pairs of legs very slender, and the fourth and fifth much stronger; branchiæ seven on each side, consisting of horizontal lamellæ; false swimming feet on under side of abdomen large, and caudal plates wide. The common shrimp (*C. vulgaris*, Fabr.) is 1½ to 2½ in. long, greenish gray spotted with brown; the carapace is smooth, except a spine behind the rostrum, one on the sternum, and seven on each side of the thorax; abdomen without ridges or spines, and middle caudal plate pointed and not grooved below. It is common on the coasts of Europe, and in England and France it is much used as food. The shrimpers catch these animals in large nets with a semicircular mouth, which they push before them along the bottom during ebb tide; this fishery gives employment to many hundred people in Great Britain. Shrimps are used in the United States chiefly as bait. They spawn throughout most of the year, carrying the eggs



Common Shrimp (Crangon vulgaris).

attached to the swimming appendages, and cast their skins from March to June. They feed on such animals as they can seize with their claws, and on what may be killed by the

waves or other causes, and are themselves devoured by fishes, aquatic birds, echini, and star fishes. Other species are found in the Mediterranean. Though the American shrimp received from Say a different name from that of Europe, there seem to be no well marked specific differences.—The long-beaked, almost transparent crustacean, commonly called shrimp in New England, and used sometimes for bait, has been described by Mr. Stimpson as *palæmonopsis vulgaris*.

**SHROPSHIRE,** or **Salop,** a W. county of England, bordering on the counties of Chester, Stafford, Worcester, Hereford, Radnor, Montgomery, and Denbigh; area, 1,291 sq. m.; pop. in 1871, 248,064. The surface is greatly diversified. Toward the frontiers of Wales it becomes wild and mountainous, while the other parts are comparatively level. The Severn flows S. E. between the elevated and the level portions, and has a course within the county of nearly 70 m., all navigable. Its chief tributaries are the Tern and the Teme. There are several small lakes, of which Ellesmere, covering 116 acres, is the largest. There is communication by canals with all the important rivers of England. The soil varies much, and there are considerable tracts of moorland, but much of it is easily worked and yields good crops. Large numbers of cattle are reared. Lead mines are worked to a considerable extent. Iron, coal, and limestone are found, and the manufacture of iron is extensively carried on. There are manufactures of machinery, glass, stone-china ware, earthenware, and coarse linen and woollen goods. The principal towns are Shrewsbury, the capital, Bridgenorth, Wenlock, and Ludlow.

**SHROVE TIDE** (A. S. *scrifan*, to absolve in confession), the days immediately preceding Ash Wednesday. These days were so designated because on them, and especially on the last of them, people were wont to confess their sins as a preparation for Lent. Shrove tide or confession tide comprised a whole week in some countries. In most Roman Catholic countries it began on the Sunday before Lent. While the ancient penitential canons were in vigor, all adults were enjoined to present themselves to the bishops and priests, in order that private penitents might be shriven in private and assigned a day for receiving communion, and that public penitents might be instructed as to what they should do to be reconciled at Easter. This practice continued substantially long after public penance had fallen into disuse. It is mentioned in the homilies of Ælfric (died about 1005) as being in force in England in his time. Shrove tide soon became a season of feasting and merriment, especially Shrove Tuesday, the eve of the long Lenten fast. This day is still called *mardi gras* (fat Tuesday) by the French, and Shrove tide is known to them as *les jours gras*. Shrove Tuesday is also popularly called Pancake Tuesday in English-speaking countries, from the common practice of eating pancakes on that day, the use of eggs having been formerly forbidden during Lent.

**SHUBRICK. I. John Templar,** an American naval officer, born in South Carolina, Sept. 12, 1778, lost at sea in 1815. He entered the service as a midshipman in 1806, and was attached to the Chesapeake in her affair with the Leopard in 1807. In May, 1812, he was made a lieutenant, and served in the Constitution in her action with the Guerriere in August, 1812, and in the Hornet's with the Peacock in February, 1813. For his services in these engagements he received medals from congress. He was second lieutenant of the President when she was captured by a British squadron in January, 1815. In that year he was first lieutenant of the Guerriere, and was present in all the operations against Algiers. On the conclusion of peace, he was despatched with the treaty to the United States in the Epervier sloop of war, which was never heard from after she left the Mediterranean. **II. William Branford,** an American naval officer, brother of the preceding, born in South Carolina, Oct. 31, 1790, died in Washington, D. C., May 27, 1874. He was appointed midshipman in June, 1806, and in May, 1807, joined the sloop of war Wasp. At the beginning of the war of 1812 he was an acting lieutenant on board the Hornet, and was soon transferred to the frigate Constellation, which rendered important services in defence of Norfolk and the navy yard at Gosport. In 1813 he was transferred to the Constitution, in which he made two cruises, and aided in the capture of three ships of war, including the Cyane and Levant (1815). When the Levant surrendered he was ordered to her command. He returned to the United States in May, 1815, second in command of the Constitution, and was awarded a sword by his native state and a medal by congress. In December, 1815, he was made senior lieutenant of the Washington, 74 guns, under Creighton, the first ship of the line which made a full cruise under the United States flag, returning in 1818. He became commander in 1820 and captain in 1831, and on Feb. 3, 1844, was appointed chief of the naval bureau of provisions and clothing. On July 9, 1846, he was appointed to command the Pacific squadron; on July 8, 1853, the eastern coast squadron; and on Sept. 8, 1858, the Brazil squadron and Paraguay expedition, from which he returned May 11, 1859. On July 16, 1862, he was commissioned rear admiral.

**SHUMLA,** a walled and strongly fortified city of European Turkey, in Bulgaria, 48 m. W. of Varna and 185 m. N. W. of Constantinople; pop. about 20,000, exclusive of the garrison. It lies on the N. slope of the Balkan, about midway between its crest and the lower Danube, in a gorge, enclosed on three sides by mountains. The inhabitants of the higher portion of the town are principally Turks; of the lower, Jews, Armenians, and Greeks. There

is trade in grain, wine, silk goods, copper ware, morocco, soap, and candles.—This town, originally called Shumen or Shumna, was burned in 811 by the emperor Nicephorus, and in 1087 it was besieged by Alexis Comnenus. It was taken by the Turks in 1387, and embellished and fortified in 1689 and the 90 years that followed, mainly by the grand vizier Hassan, whose tomb is the most remarkable monument of the city. In all the wars between Turkey and Russia, it has formed the point of concentration of the Turkish army. The Russians attempted unsuccessfully to take it in 1774, in 1810, and in 1828.

**SHURTLEFF COLLEGE,** an institution of learning under the control of the Baptists, at Upper Alton, Madison co., Illinois, 1½ m. E. of the city of Alton. It was established in 1832 under the title of Alton seminary, and chartered in 1835 as Alton college. In 1836 its name was changed in honor of Benjamin Shurtleff, M. D., of Boston, who had given it $10,000. It was designed especially for the education of young men for the ministry, but a distinct theological department was not organized till 1863. The institution now consists of an academic and preparatory department, Kendall institute for young ladies, the college, and the theological department. Both sexes are admitted to the academic and preparatory department and to the college. The latter has a classical and a scientific course, on the completion of which the degrees of bachelor of arts and bachelor of philosophy respectively are conferred. Kendall institute, established in 1873, has a fine building and grounds, and is chiefly used as a home for young ladies attending the other departments. Tuition is free in the theological department, and several scholarships have been founded to provide for the tuition of needy students in the other departments. Additional aid is afforded to needy candidates for the ministry by the "Illinois Baptist Education Society." The libraries of the institution contain 7,300 volumes. The number of instructors in 1874–'5 was 14; of students, 204 (154 males and 50 females), viz.: theological department, 5; college, 53; academic and preparatory department, 146. The whole number of students has been 3,825; of graduates, 159. The property of the institution amounts to about $180,000; the debt to $30,000.

**SHUVALOFF, Peter Andreyevitch.** See p. 879.

**SIAM,** the chief kingdom of the peninsula styled Indo-China, or Further India. Siyam, from the dark color of the inhabitants or of the soil, is the ancient, and Muang T'hai, the kingdom of the free, the modern native appellation for the country; T'hai, the free, for the people. With its Laos, Cambodian, and Malay peninsular dependencies, it lies between lat. 4° and 22° N., and between lon. 97° and 106° E.; greatest length 1,350 m., breadth 450 m.; area estimated at about 300,000 sq. m.; pop. about 5,750,000. The capital is Bangkok. Siam proper lies mainly between lat. 13° and 18° and lon. 98° and 102°, being bounded by its dependencies, the gulf of Siam, and the British territory of Tenasserim. Two mountain ranges, extending mainly S. E. from the Himalaya, form general natural divisions from China on the north, and partly from Anam on the east and Burmah and the British possessions on the west. A third range, less continuous and direct, passes through the central regions; in this is situated the P'hra Bat, or mountain of "the sacred foot" (footprint) of Buddha, a Mecca for Buddhists. The gulf of Siam, between Siam proper and the Malay peninsula, forms a long coast line, and has numerous islands, much precipitous shore, and several ports, of which Bangkok is the chief. It is never visited by typhoons or heavy gales.—The country is watered by several rivers, bearing the generic name Menam, "mother of waters," and taking the specific name or names from cities or provinces. The Menam Kong, Mekong, or river of Cambodia, 1,800 m. long, traverses in its middle course the N. E. or Laos dependencies of Siam. (See MEKONG.) The Menam Chow P'ya, Menam Bangkok, or simply the Menam, rises in the north and flows S. through the centre of Siam proper into the gulf of Siam. Its length is about 600 m.; its principal tributary is the Meping from the west. Bangkok, Ayuthia, Angtong, and other towns are situated on the Menam. The Salwen flows on the border of British Burmah. These rivers, with the very numerous intersecting canals, for rowing, not tracking, are the great highways of traffic. The plains, irrigated and enriched by their annual overflow, are extensive and fertile; the valley of the Menam equals in richness that of the Nile, and in extent half of the state of New York.—The seasons are two, the wet or hot and the dry or cool. The former, opening near the middle of March, is not a succession of wholly rainy days, but resembles a New York April and August combined. The annual rainfall is about 60 inches. April, the hottest month, has at Bangkok a maximum of 97° F. and a mean of 84°. In October the S. W. monsoon gives place to the N. E., which ushers in the dry and cool season; this is very fine, with only a few light showers throughout. January is the coolest month; but the mercury rarely falls below 65°. The mean annual temperature is 82½°, and the mean range 13°. Vegetation is luxurious, fruitful, and beautiful beyond description, and the soil yields a rich return to rude and careless cultivation. Rice, sugar, pepper, cotton, and hemp are the staple products. In the abundance, variety, and excellence of fruits, vegetables, and spices, Siam is unsurpassed. Many fruits, as the durian, mangosteen, and custard apple, are cultivated in large gardens or orchards, trenched, and watered by the daily tide. In the forests are found gutta percha, lac, dammar, gamboge, catechu, gum benjamin, and the odoriferous agila or eagle wood; innumerable medicinal

plants, herbs, and roots; sapan, fustic, indigo, and other dyes; the lofty silk-cotton tree, with its soft silky floss for mattresses, but too brittle for the loom; the bamboo, the rattan, and the atap, together forming the material of three fourths of the houses; the teak, with other ship and house timbers; iron, red, and white woods, rose woods, and ebony; the banian, and the sacred fig tree. The animal kingdom is no less varied and interesting. Most celebrated is the white elephant, a dark-cream albino, prized and honored as very rare, and when captured belonging to the king. The national standard is a white elephant on a crimson ground, and the royal seal, medals, and money bear the same device. Albino deer, monkeys, and even tortoises are sometimes found, and the natives believe white animals to be the abode of transmigrating souls. The elephants of Siam attain a size and strength unsurpassed in other countries, and are much prized throughout India. Among other animals are the rhinoceros, tiger, leopard, bear, pangolin, otter, musk civet, wild hogs, ourang outangs and other apes, monkeys, and deer; dogs and cats, wild and domestic, are innumerable. The forests abound in peacocks, pheasants, pigeons, and other birds; aquatic birds of all kinds are numerous; the sea swallow which produces the edible nest is common. Among the reptiles are the crocodile, turtle, python, cobra de capello, numerous other snakes, and several varieties of lizards. Fish are plentiful, but of poor quality. The most noteworthy insect is the *coccus ficus*, which produces the lac of commerce by punctures in resinous trees. Gold, copper, iron, tin, and lead all abound, in great purity; but by reason of the rudeness of working, the jealousy toward foreigners, and the fevers and hardships of the jungle, their vast wealth is comparatively undeveloped. Antimony, zinc, sulphur, and arsenic also exist, and silver in combination. Salt is largely manufactured by solar evaporation, and saltpetre less so. Mining, previously under the strict surveillance of government, and carried on chiefly by Chinese, has recently excited some interest among Europeans. Rubies, spinel, corundum, sapphire, amethyst, garnet, topaz, and other precious stones are found.—According to the French consul Garnier at Bangkok (1874), the population of Siam proper and its Laos dependencies is composed of 1,800,000 Siamese, 1,500,000 Chinese, 1,000,000 Laos, 200,000 Malays, 50,000 Cambodians, 50,000 Peguans, and 50,000 Karens and others. The Siamese are of Mongolian origin and Laos or Shyan descent. They are olive-colored and of medium height. The head is large, face broad, forehead low, cheek bones prominent, jaw bones in retreat very divergent; mouth capacious, lips thick, nose heavy, and eyes black and without the Chinese turn of the lid. The teeth are stained black, and sometimes serrated. The hair is all plucked from the face in youth, and the most of the head is shaved bi-monthly. A black bristling tuft 4 or 5 in. broad and 2 in. high is left on the top; that of the women, whose hair is only closely cut, is often encircled by a thread of bare skin whence two or three hairs' breadths have been uprooted. The dress consists of a cotton waist cloth (to which women add a silk shoulder scarf), a jacket for the cold, and a straw hat for the sun. Children under seven or eight years old are clad only in jewels, fig leaves, flowers, and turmeric. Priests, with head entirely shaven and uncovered, wear several yellow robes of cotton and silk. Kings and nobles on state occasions wear silk and gold brocades and high conical hats. The Siamese are indolent, greedy, and untruthful, intemperate, servile, and superstitious. At the same time they are peaceable and polite, decorous in public, and affectionate to kindred and kind to the poor and imbecile. The dwellings are of one story, partly to prevent the indignity of another's walking over the head. They consist of huts, built on piles, of bamboo, roofed and sided with atap leaf; boats, serving also as peddling stalls or vehicles; floating houses, of panelled teak, rising and falling with the tide on bamboo rafts; and palaces, of white stuccoed brick, adorned with gilding, carving, painting, foreign furniture, pictures, gold, silver, china, and glass. These palaces are not of Chinese, but rather of Indian architecture, and they often occupy several acres, with the dwellings of the wives, the quarters of the servants, and the grounds, which are paved, shaded, adorned with flowers, and enclosed by high walls Marriage takes place as early as 18 for males and 14 for females, without the aid of magistrates or priests, though the latter may be present to make prayers, and especially to feast and to receive presents. The number of wives, ordinarily one, in the palaces reaches scores and hundreds; but the first is the wife proper, to whom the rest are subject. Social distinctions are very numerous, and in the law are represented numerically, from 100,000 for the second king down to 5 for the lowest slave. Before "the lord of life" on the throne, far above numerical representation, all crawl and crouch, or, with head bowed to the ground, lie "dust at the sacred feet." Prince is approached by noble, noble by lord, lord by master, &c., each with body bent, eyes prone, and hands folded and raised to the forehead or above the head, giving and receiving homage. An annual service of three months is paid to the king by all, save the Chinese triennially taxed. One third of the common people, it is largely estimated, are slaves by birth, by gambling or other debts, by redemption from the penalty of crime, by capture, &c. Men sell their children, their wives, or themselves; convicts in scores clank their chains about the streets; villages of thousands are made up of foreign captives. Yet Siamese life is in the main comfortable, and is moreover gladdened by many

sports, amusements, and holidays. On all great occasions the coffers of kings and nobles are opened widely for merrymaking for the people, and merit-making for themselves. The only honorable disposal of the dead is by burning. The badges of mourning are white robes and an entire shaving of the head. A limited and superficial education is afforded gratuitously at the temples, to the males, 80 or 90 per cent. of whom read. The drama is much cultivated, and dramatic companies are attached to the palaces and gaming houses. The music is unwritten, simple, plaintive, and pleasing. Bands of 10 or 12 instruments, most resembling Javanese, are a part of every wealthy establishment. Gaudy and incongruous paintings, of rude perspective, chiefly adorn the temples. The medical art is in a barbarous state. Nowhere else does Buddhism hold so pure and absolute a sway as in Siam. It is of the Ceylonese rather than Chinese type. The wats or temples, resembling not the Chinese, but distantly the Egyptian architecture, are among the most beautiful and splendid in the East. They are in vast, choicely situated, paved parks, with white walls gleaming through the leaves, serrate roofs and spacious domes and lofty *prachadi* spires, all painted and gilded and glazed, vocal with air-rung bells, and resplendent in the sunlight. One is estimated to have cost, with all its paraphernalia, over $800,000. (See Bangkok.) Missions have been carried on by the Roman Catholics, under the greatest vicissitudes, since the middle of the 16th century. The missionaries are French, and their converts were reckoned in 1872 at 10,000 in 16 congregations. At the head of the mission is a vicar apostolic. Protestant missions date from the visits of Gützlaff, Tomlin, and Abeel in 1828–'31, and properly from the settlement of Jones in 1833. Representatives of the American Baptist missionary union, of the Presbyterian board of foreign missions, and of the American missionary association have established several Protestant congregations, schools, and religious papers. The number of the Baptist congregations in 1874 was 154, and of Presbyterian 38.—In commerce Bangkok once ranked second only to Calcutta and Canton in the far East; but monopolies, exorbitant duties, and numberless restrictions had well nigh stifled production and banished trade till in 1855–'6 new treaties were negotiated for Great Britain, the United States, and France, by Sir John Bowring, Townsend Harris, and Count de Montigny. The purchase of land is now allowed; the monopolies and tonnage duties are abolished; imports pay 3 per cent. in money or kind, and exports one duty only, according to tariff. In 1873 the number of Siamese vessels entering the port was 157, tonnage 55,049; British 84, tonnage 32,406; German 15, tonnage 4,731; French 14, tonnage 5,198; American 1, tonnage 388. The total arrivals in 1873 were 386, tonnage 102,454; clearances 265, tonnage 97,212. The principal exports are rice, sugar, pepper, sesamum, sapan wood, hides, and cardamoms. Their total value in 1873 was about $4,600,000; that of the imports, $4,000,000. The most important trade is that with China, carried on in junks built and navigated by Chinese. The junks leave the Menam generally in June, returning in December. The tical, a silver coin bearing the device of an elephant and weighing 236 grains troy, with bars of silver cut into pieces, stamped, and bent into an irregular oval, in value 7½, 15, and 60 cents, with cowries, form the currency. Dollars are also current, though usually exchanged for silver ticals at the rate of three dollars for five ticals. The rate of interest is about 30 per cent. The inland trade is conducted chiefly by boats. Foreign steamers ply between Bangkok and Singapore. The United States and European treaty powers are represented by resident consuls at Bangkok. —The government of Siam is theoretically a duarchy, practically a monarchy. While there is a second or vice king, the first or senior king is actual sovereign. The crown is hereditary, but without primogeniture, being bequeathed, with the sanction of princes and nobles, to any son of the queen; but intrigue and violence have often diverted the succession from the high royal line. A royal decree of May 8, 1874, announced that in future the king would give important laws only after consulting the council of state and the ministry. The council of state comprises the first king as president, the ministers, who have no vote, from 10 to 20 councillors, who have to draft new laws and from their own number elect a vice president, and six princes of the royal house. Any two members of the council may submit a new law to the king. The ministry (*senabodi*) consists of an honorary president, three ministers of the interior (of the west, the north, and the east), and the ministers of agriculture, justice, the royal house, and finance. The minister of finance may be dismissed at any time; the dismissal of any other minister requires a sentence of the court. The country is divided into 41 provinces, each of which is governed by a *phraya* or council of the first class. There are also several territories which have their own princes, tributary to the king. The king is by title "sacred lord of heads," "possessor of all," and property and life are at his will, to be taken at governmental necessity or caprice; but many considerations conspire to render a violent and arbitrary exercise of this absolute power comparatively unfrequent. The queen consort, the wife supreme among hundreds, must be of native and royal blood, and she is rigidly kept from all possible intercourse with an inferior of the other sex. She never becomes regent, or takes any part in political affairs, but is treated with the highest deference. She has a separate court, in which appear the princesses, who, not allowed to marry beneath them, rarely marry at all. She has her fe-

male guards in uniform and arms. The number of females within the palace is, on royal authority, 5,000, and of males about the same. The second king has also a separate palace, seraglio, officers, retainers, and soldiers, only second to those of the first. Though never appearing at the audiences of the nobles with the senior king, his opinion and sanction are sought on important state policy, and his name is associated in treaties. His position seems to be that of counsellor, not of co-ruler or successor. The larger portion of the public revenue is embezzled by the numerous officers, who receive only a nominal salary. The revenue of the king is estimated at about $4,000-000. There is a very ancient written code of laws, the acts and decisions of the kings, and an unwritten code, scarcely less authoritative, of traditional usages; both are often absurd, unjust, and cruel, and both liable to be disregarded at the royal will. More than 25 classes are excluded from testifying, many for the most trivial reasons. The penalties are various, from bambooing to beheading. Capital crimes are now very few. Treason, very comprehensive, is punished by beating the convict, enclosed in a large sack, nearly to death, and then casting him loaded into the river. The military force is small, and is disciplined by European officers. In time of war all male inhabitants are liable to service. The fleet consists of seven men-of-war carrying 40 guns. —The history of Siam dates back some centuries before Christ, but only the annals subsequent to the founding of Ayuthia, the former capital, A. D. 1350, can be deemed authentic. In the 16th century the dominion extended to Singapore, and the first western connection was made with the Portuguese and Spanish. In 1604 the Dutch established relations; in 1662 an English ship arrived; and the latter part of the century is remarkable for the grand embassies from and to Louis XIV. of France, and the later bloody and almost utter overthrow of French influence. In 1782 the present dynasty ascended the throne, and transferred the seat of government from Ayuthia (sacked by the Burmese) to Bangkok. In 1822 and 1825 treaties were made with Great Britain, or rather with the East India company, through Mr. Crawfurd and Capt. Burney. In 1833 a treaty was made with the United States through Edmund Roberts. The first embassy from the country for nearly two centuries was sent to England in 1857; and another was sent to France in 1861. In 1868, on the death of his father, the reigning king ascended the throne, with the title Phrabat Somdetya Chula Lankarana, and during his minority a regent carried on the government; he became of age Nov. 16, 1873. The name of the present second king (1875) is Kroma Phraratcha. The recent kings of Siam have been among the most remarkable characters of the East by their attainments in languages and general information, adoption of foreign ideas and improvements, wise and humane government, and liberal and enlightened intercourse with foreigners and foreign powers. In January, 1875, a conflict arose between the first and second kings, the latter for a time taking refuge with the British consul; but a reconciliation was soon effected.—The best books on Siam are Crawfurd's "Embassy to Siam and Cochin-China" (London, 1828); Pallegoix's *Description du royaume Thai ou Siam* (Paris, 1854); Bowring's "Kingdom and People of Siam" (London, 1857); Bastian's *Reisen in Siam* (Berlin, 1867); Mrs. Leonowens's "English Governess at the Siamese Court" (Boston, 1870); McDonald's "Siam, its Government, Manners, Customs," &c. (Philadelphia, 1871); "Siam, or the Land of the White Elephant," compiled by the Rev. George B. Bacon (New York, 1873); and "The Land of the White Elephant," by Frank Vincent, jr. (New York, 1874).

**SIAM, Language and Literature of.** Siamese is spoken from Burmah and British Burmah on the west to Anam and Cambodia on the east, and from the Malay state of Keddah on the south to the confines of China on the north. The dialectical variations are numerous, and the language is spoken well only in Bangkok and by persons educated there. (See INDO-CHINESE RACES AND LANGUAGES.) The Siamese alphabet, supposed to be derived from the ancient Cambodian letters still used in Siamese sacred books, and ultimately from the original Pali alphabet, consists of 44 consonants and 20 vowels, including diphthongs and semi-vowels. The gradation of the vowel sounds is very delicate, and some of the consonants are but slightly changed forms of the same letter, indicating the tone in which they are to be uttered in certain syllables. The English *g*, *j*, *v*, *x*, and *z* are wanting. The *th* sound, though frequent in Burmese, is entirely unknown in Siamese, the *th* used in transcriptions of the latter representing an aspirated *t*, or a combined utterance of the two sounds *t* and *h*. According to the tone in which it is uttered, a word has several distinct meanings, by means of which the otherwise very meagre vocabulary is considerably increased. Thus *hkai*, *hkai*, *hkai*, pronounced in the same tone, would mean who? who? who?; but enunciating each with a different tone, it may be made to mean "Who sells eggs?" This same word *hkai* may further be made to signify a fever, to open, rough, fortress, or camp, by other intonations. Besides the parts of speech distinguished in English grammar, there is in Siamese a peculiar class of numeral or classifying nouns. Such a word is *lam*, which is used in conjunction with objects having the quality of length, as ships and palm trees; others of this class are *an*, *toa*, *luk*, *ton*, and *met*, all of which must be used when speaking of one or another class of objects. Three genders, masculine, feminine, and common, are distinguished by the grammarians, but in common speech and in poetry gender is

commonly disregarded, except in distinctions of sex, which is indicated by the addition of special words. The plural is expressed by adding some word like *hlai*, many, or *mak*, much. There are no inflections, and case is indicated by the use of a preposition, or by the position of the word in the sentence. There is a great variety of pronouns, or pronominal expressions, and the proper use of one or another depends on the relative rank of those writing or speaking. Moods and tenses are indicated by prefixes and suffixes, or by auxiliary verbs; thus *hka bok*, I say; *hka dai bok*, I have said; *hka cha bok*, I shall say, &c. The Siamese are very fond of using words in pairs, for euphony, distinctness, or figurativeness.—Siamese literature is not of a very high order. The works on history and medicine contain little else but fables and quackery. The law books are very elaborate, but wanting in legal acumen and precision. The religious and philosophical productions are based upon the Pali scriptures and Chinese learning, and exhibit nothing of an original growth. The books of Siamese proverbs, however, have been praised as containing much social wisdom sharply put. The best productions of Siamese literature are works of fiction, poems, and dramas, though a large portion of them are borrowed from or imitations and adaptations of Hindoo works.—See Pallegoix, *Grammatica Linguæ Thai* (Bangkok, 1850), and *Dictionarium Linguæ Thai* (Paris, 1854); Bastian, *Reisen in Siam* (Berlin, 1867), which contains learned disquisitions on the language and literature of the country; Alabaster, "Wheel of the Law" (London, 1871); and the "Siam Repository," a journal published at Bangkok in English.

**SIAMESE TWINS.** See MONSTER.

**SIBERIA**, a part of the Russian dominions occupying the whole of northern Asia, bounded N. by the Arctic ocean, E. and S. E. by Behring strait, Behring sea or the sea of Kamtchatka, and the seas of Okhotsk and Japan (inlets of the North Pacific), S. by China and the Russian provinces of central Asia, and W. by European Russia, from which it is separated by the Ural mountains. As officially bounded, it extends from lat. 41° 30′ to 77° 50′ N., and from lon. 59° 30′ to 190° E.; length about 3,600 m., breadth 2,000 m.; area, 4,826,-329 sq. m.; pop. in 1870, 3,428,867. It is divided for administrative purposes into the four governments of Tobolsk, Tomsk, Yeniseisk, and Irkutsk, and the four provinces of Transbaikal, Yakutsk, Amoor, and the Littoral or Primorsk. In a geographical sense, however, the four northern provinces of Russian Central Asia, Semipolatinsk, Akmolinsk, Turgai, and Uralsk, and portions of the governments of Perm and Orenburg, also belong to Siberia, and will be included in parts of this description. Tobolsk comprises the western end of Siberia, as officially constituted, and extends from the Arctic ocean to the Central Asian province of Akmolinsk. Tomsk lies E. of it on the borders of the Central Asian province of Semirietchensk. Yeniseisk includes the Arctic coast from the gulf of Obi to the river Anabara, and extends S. to the borders of Mongolia. Irkutsk lies between Yeniseisk and Lake Baikal, and the Transbaikal province east of Lake Baikal. Yakutsk comprises the Arctic coast from the Anabara river to Cape Shelagski, extending S. to the Amoor province, which includes the country on the left bank of the Amoor from the Stanovoi mountains to the N. E. extremity of Mantchooria. The Littoral province covers the entire E. coast from Cape Shelagski in the Arctic ocean to the sea of Japan, including the Tchuktchi peninsula, Kamtchatka, the district of Okhotsk, the lower course of the Amoor, and the island of Saghalien.—The coasts of Siberia, both along the Arctic ocean and the seas on the east and south, are indented by many bays and inlets. On the N. coast the first large inlet, beginning at the W. extremity, is Kara bay, an offshoot of the Kara sea lying between Siberia and Nova Zembla. Next is the gulf of Obi, an inlet of the same sea, which forms between it and Kara bay the Yelmert or Samoyed peninsula. It receives the Obi or Ob at its S. W. extremity. A branch on its E. side is called the Taz gulf. The gulf of Yenisei, the outlet of the river of the same name, forms with Khatanga gulf, the outlet of the Khatanga river, the Taimyr peninsula. On the W. side of Taimyr bay is Cape Taimyr or Northwest cape, and on its E. side, at the extremity of a long peninsula, is Tcheliuskin or Northeast cape, the northernmost point of Asia, in lat. 77° 50′ N. Between Khatanga gulf and Behring strait are many smaller bays, most of which are the outlets of some of the numerous rivers which empty into the Arctic ocean. The principal islands off the N. coast are the Liakhoff or New Siberia group, extending 205 m. opposite the shore between the mouths of the Yana and the Indigirka; the largest, Kotelnoi, is 100 m. long by 60 m. broad; the next in size is called Fadeyeff, and the next New Siberia. Between the main group and the coast are smaller islands called Liakhoff and Maloi. The surface of the islands is covered with alternate layers of sand and ice, and in their hills are immense alluvial deposits filled with wood and the fossil bones of animals. Great quantities of fossil ivory have been obtained from them and the neighboring coasts of the mainland. N. of the coast, about the 180th meridian, and separated from it by Long strait, is Wrangel's, Plover, or Kellett land, of unknown extent. Along the whole Arctic coast of Siberia the sea is frozen for more than half the year; and in the warmer seasons the ice floats in such masses as to render navigation always dangerous and often impossible. A large part of the coast is unexplored, and all efforts to double Cape Tcheliuskin have been unsuccessful; but Lieut. Tcheliuskin, from whom it is named, reached its north-

ernmost point in 1742 in a sledge. The easternmost point of Siberia is Cape East at the end of the Tchuktchi peninsula, which juts into Behring strait, opposite Cape Prince of Wales in Alaska, the westernmost point of the American continent. On the S. side of this peninsula is the bay of Anadyr, an inlet of Behring sea. The coast follows thence a general southwesterly direction to the end of the peninsula of Kamtchatka, W. of which lies the Okhotsk sea, separated from the Pacific by the chain of the Kurile islands stretching from Kamtchatka to Yezo. Of the islands of Behring sea, only Behring and Copper islands and those lying close to the coast belong to Russia.—The surface of Siberia is in its general form a vast diluvial plain, slightly undulating, and sloping gradually from the Altai mountains on the south to the Arctic ocean. In the W. part are the steppes of Ishim and Baraba, broad tracts of lowland in which grassy prairies alternate with reed marshes, fresh lakes with salt, and tracts of rich arable land with extensive forests. Parts of this region present in summer fine park scenery, in which beautiful wooded hills rise from grassy plains covered with flowers. Here the birches often attain a diameter of 4 ft. and a height of 150 ft., and the pines much greater dimensions. S. and E. of the steppes the spurs of the Altai mountains jut into the plain like the headlands of a seacoast. Many of the great rivers rise here, the upper part of their courses being through dense forests. In eastern Siberia the plain is more broken by hills, and has but little land fit for agriculture. In the S. part of Irkutsk and in Yakutsk the hills and mountains are covered for most of the year with good pasture, and in favorable places all the grains of temperate climates are grown. The greater part of the country is covered with open forests, in which there is tolerable pasturage at certain seasons. Between the Kolyma river and Behring sea the country is traversed by several mountain ranges having a general elevation of 2,000 to 3,000 ft. above the sea. The entire N. coast of Siberia is a dreary region of salt steppes and frozen swamps, called the *tundra*, where the soil is perpetually frozen to the depth of hundreds of feet. The surface is never thawed before the end of June, and is again ice-bound by the middle of September, and deep snow covers the ground nine or ten months in the year. The banks of the rivers are lined with vast numbers of uprooted trees brought down by floods, which eventually find their way into the Arctic ocean, to be drifted away by the current flowing from E. to W. along the Siberian coast.—The principal mountain range of Siberia is that which forms in the west its S. boundary with China, and which is called by various names in different parts. Its E. extremity is at East cape in Behring strait, whence it extends in a general S. W. direction, forming the boundary between the Littoral, the Amoor, and Yakutsk provinces, until it reaches the Chinese frontier, when its course is first S., then W., and then N. W. to the boundary between Irkutsk and Yeniseisk, from which it again runs S. W. to the borders of Turkistan. In the east and along the shores of the sea of Okhotsk this range is called the Stanovoi mountains, W. of the Amoor province the Yablonnoi, further W. the Daurian and Sayanian mountains, and finally the Altai mountains in the narrower sense. The general height of the chain (the Altai in its widest sense) is about 3,000 ft., but the highest summits of the Altai proper reach an elevation of upward of 10,000 ft., and the Yablonnoi mountains are little more than an undulating plateau. There are many spurs from the main range, as well as several smaller ranges in the interior. (See ALTAI, AMOOR COUNTRY, and KAMTCHATKA.)—With the exception of the Amoor and a few streams of less importance, the rivers of Siberia all flow into the Arctic ocean. The Obi ranks among the largest rivers in the world, and many of its tributaries are of great size; the most important of these are the Irtish, Ishim, Tobol, and Tom. The Yenisei is by some authorities said to drain a greater extent of surface and to have a longer course than the Obi; its chief affluents are the Lower Tunguska, Stony Tunguska, and Upper Tunguska or Angara. The Lena is nearly as large, and the principal streams which join it are the Viliui, Vitim, Olekma, and Aldan. The other rivers of most importance which flow into the Arctic ocean are the Nadym, Pur, Taz, Piasina, Khatanga, Anabara, Olem, Olenek, Yana, Indigirka, Alazeya, Kolyma, and Tchaun. The chief rivers flowing into the seas which bound Siberia S. E. are the Amoor or Saghalien, which forms part of the southern boundary and receives several considerable tributaries from the north; the Anadyr, flowing into the gulf of the same name; and the Okhota, which has its mouth on the W. shore of the sea of Okhotsk. Few of these rivers present any obstacles to navigation except ice. Frozen inundations are frequent. As the rivers flow from warm to cold latitudes, their lower and middle courses freeze while their head waters are still open. Near their mouths they freeze to the bottom, while above for hundreds of miles only the surface is frozen. The waters accumulating under the ice finally burst from confinement and flood the valleys with many thicknesses of ice. At the close of winter these accumulations are sometimes 20 ft. in depth. There are many lakes, but they are all small, with the exception of Baikal, between the Transbaikal province and the government of Irkutsk. (See BAIKAL.)—The geology of Siberia is but little known, excepting in a few parts. Granite and crystalline schists are found in the Ural mountains, and also in the Altai and its E. continuations, between lon. 85° and 120° and as far N. as lat. 57°, and again in the E. extremity of the country between lon. 165° and Behring strait. Volcanic

rocks occur chiefly in the south, and are found along with the granite and crystalline schists; and there are a few active volcanoes. Other rocks, belonging to the Silurian, Devonian, and carboniferous systems, are found in the south and extending toward the interior of the country. The tertiary formation is the most extensively developed, and is found throughout the whole of Siberia. The shores of the Arctic ocean are covered for a considerable distance inland, and for a great part of their extent, by a deep alluvial deposit which contains immense numbers of fossil remains of extinct species of elephants and other animals, from which large quantities of ivory are procured. (See MAMMOTH.) Mining operations in Siberia are confined to three parts of the country. The westernmost district is on the E. face of the Ural mountains, and occupies a tract about 40 m. broad, extending between lat. 56° and 60°; gold, silver, platinum, copper and iron ores, and precious stones, are all found in this territory. This region is, however, not officially included in Siberia. (See YEKATERINBURG.) The second district lies on the N. side of the Altai mountains, in the neighborhood of the head streams of the river Irtish; silver and copper are found here, and gold and lead in smaller quantities. The third district lies in the Yablonnoi mountains, E. of lon. 120°; in this gold, silver, lead, zinc, antimony, iron, and arsenic are all found, and there are emerald and topaz mines of great value. Diamonds are occasionally found on the E. slopes of the Ural mountains. Porphyry, jasper, and malachite, for ornamental uses, and mica, used as a substitute for window glass, are common. Salt is found in great abundance on the steppes, and on the surface of some of the lakes, where the summer heat rapidly evaporates the water and leaves masses of crystallized salt, sometimes 8 or 9 in. thick, and so solid that beasts of burden pass over in safety.—The climate of Siberia is much colder than in corresponding latitudes in Europe. At Ustyansk, at the mouth of the river Yana, in lat. 70° 55′, the mean annual temperature is 4·39° F., while at North cape in Europe, a few minutes further north, it is 32°. At Irkutsk, in lat. 52° 17′, 1,240 ft. above the sea, the mean temperature is 31°; in winter quicksilver freezes, and remains so for about two months. In 1864 Pumpelly saw the thermometer indicate 70° below zero at a station near Irkutsk. The severity of the climate increases toward the east. At Nizhni Kolymsk, at the mouth of the Kolyma, in lat. 68° 31′, lon. 160° 56′, and nearly on a level with the sea, the river freezes over in the beginning of September, and is not again free from ice till the beginning of June. The sea begins to freeze in October, but the cold at this time is somewhat diminished by vapors which rise from it before the ice forms. In January the thermometer falls to 60° below zero, and respiration becomes difficult. The cold is almost as great in February, but in March it begins to decrease perceptibly; the wind blows from E. S. E., and the temperature rises to 29°. In June it is sometimes 72° at noon; and in July the heat is very great, and the atmosphere is filled with swarms of gnats, which compel the reindeer to migrate from the forests to the open country on the shores of the sea. In August frosts begin at night and the temperature rapidly decreases.—Forests cover a large part of southern and central Siberia, but the tundra on the N. coast is bare of trees. The birch, larch, fir, pine, willow, poplar, elm, and Tartar maple are the principal trees. The silver poplar is found as far north as lat. 60°; the silver fir ceases at about 60° 50′; the polar limit of birch is about 63°, although dwarf specimens are sometimes seen further north; the pine is found on arid slopes and heights in lat. 64°, and the red fir (*pinus abies*) disappears about the same parallel. Larch trees with twisted trunks and many branches are found in the southern part of the tundra. On the most desolate steppes and mountain sides, from the Okhotsk sea to the Arctic ocean, grows the trailing cedar, called *kedrevnik* by the Russians. It has needles and cones like the common white pine; it never stands erect, but covers the ground under the snow with a network of gnarled, twisted, and interlocking trunks. It furnishes almost the only firewood of the wandering natives, and without it N. E. Siberia would be nearly uninhabitable. With the opening of summer the melting snows are rapidly followed by foliage and flowers, and the whole region is converted for a short time into a blooming garden. The flora of Irkutsk is richer than that of Berlin, exhibiting the plants of warmer countries beside those of the arctic regions. Turtchaninoff discovered 1,000 phanerogamous plants in its neighborhood, many of them of unknown species.—Along the banks of the rivers, particularly in S. W. Siberia, is much land well suited for agricultural purposes. Wheat, barley, rye, buckwheat, oats, and hemp are grown, and some inferior tobacco. Grain is cultivated as far north as lat. 61°, and turnips and other vegetables of temperate climates thrive in favorable places. Reindeer and wild sheep are found on the mountains which separate Siberia from Mongolia, and the former roam in vast herds throughout the N. part of the country. The Bengal tiger and a species of panther (*felis irbis*) also inhabit these mountains, and are sometimes seen much further north. The Caspian antelope is found in the southwest, and the black and arctic or stone fox in the north. Sables, ermines, marmots, martens, and squirrels abound in the south. The white bear, the lynx, the wolf, the wild hog, and the glutton are common everywhere. The dog of the country, which bears a strong resemblance to the wolf, is used to drag sledges. The animals belonging to central Asia are nearly all found in the S. part of Siberia. Camels are kept by the Calmucks and some other tribes, but do not

live N. of lat. 55°. The domestic sheep are of two species, the Russian and the broad-tailed Kirghiz; the latter are chiefly kept by the nomadic tribes, single herdsmen of whom sometimes possess flocks of 10,000 head. The horned cattle of Russia degenerate in size in Siberia. The horses are good, and generally white, but sometimes they are singularly marked. Fish are very numerous. Ducks, geese, swans, woodcocks, partridges, and other fowl abound in the S. part of the country.—The population of Siberia is composed of various tribes and races. More than half are Russians or their descendants, some of whom came to the country as volunteer immigrants, but the greater part were sent as exiles. These exiles consist of three classes, criminals and political and religious offenders. The worst class are condemned to the mines, and those whose offences have not been so great are employed at less laborious work, while the rest are formed into settlements under the supervision of the police, and receive grants of land for cultivation. None except the worst criminals are sent to Siberia without their families. In 1874, from May to October, 16,889 persons were banished to Siberia. Of these 1,700 were sentenced to hard labor, and 1,624 were drunkards and vagrants. They were accompanied voluntarily by 1,080 women and children over 15 years of age, and 1,269 younger children. Among the native tribes are the Samoyeds in the N. W., and the Ostiaks, who occupy the country S. of them as far E. as the river Yenisei; these people live by fishing and hunting, and but few of them have been converted to Christianity. In the S. W., besides some hordes of Bashkirs, are the Kirghiz, occupying the steppes of the Ishim and Irtish, commonly called from them the Kirghiz steppes; they are still in a barbarous state. Among the inhabitants of the W. parts of the Altai mountains the most numerous are the Calmucks, who have become partially civilized and have laid aside many of their national peculiarities; they manufacture iron and gunpowder, and cultivate some grain and tobacco, but their chief subsistence is drawn from their flocks and herds. Their religion is made up of various superstitions. On the slopes of the E. part of the Altai chain are several tribes known as Beruisses, Beltirs, Sagai, and Katchins. The Buriats are of Mongol origin, bear a strong resemblance to the people of N. China, and are the most numerous native tribe in Siberia; they are found chiefly about Lake Baikal and E. to the river Onon, a tributary of the Amoor. Most of the nations of N. E. Siberia may be referred to one or the other of three classes, the Yakuts, the Tunguses, and the Tchuktchis and Koriaks. The Yakuts, settled chiefly along the Lena, from its source to its mouth, are of Tartar origin, speaking a language said to resemble closely the Turkish. They are all more or less civilized by Russian contact, many having adopted the Greek faith, and are the most thrifty and industrious of the nations of N. Asia. The Tunguses, and the allied tribes, the Lamuts, the Monzhurs, and the Gilyaks of the Amoor river, all of Mongol origin, are found as far W. as the Yenisei and as far E. as Anadyrsk in lon. 169°. They are amiable, and easily governed and influenced. Their original religion was Shamanism, but they now profess almost universally the Greek faith. They train reindeer for riding and pack-carrying (the other nations using them only in sledges), and pay a regular tribute in furs to the government. The Tchuktchis and Koriaks, inhabiting the extreme E. part of Siberia, between the 160th meridian and Behring strait, strongly resemble the North American Indians in general appearance, and are tall, vigorous, and athletic. A part of them are settled along the seashore, but most are nomadic. The latter own large herds of reindeer, numbering frequently several thousand, and their wandering life is a necessity to provide food for them. The Tchuktchis and Koriaks are independent of civilization, impatient of restraint, and bold and self-reliant. They are the only Siberian tribes that ever made a successful stand against Russian invasion. Nearly all the Siberian nations eat a species of toadstool, called by them *muk-a-mur*, which in small doses produces all the effects of alcoholic liquor, but when eaten in large quantities is a violent narcotic poison. Its habitual use shatters the nervous system, and its sale to the natives by traders is made a penal offence by Russian law. In respect to religious belief the inhabitants are divided as follows: Orthodox Greeks, 2,875,533; Raskolniks, 65,505; Armenian Greeks, 9; Roman Catholics, 24,754; Protestants, 5,722; Jews, 11,400; Mohammedans, 61,083; pagans, 283,621. The population in towns numbers 113,236.—Although the manufactures of Siberia are not extensive, a remarkable spirit of enterprise among the people is rapidly developing the industrial resources of the country. In most of the chief towns there are manufactories of cotton and woollen cloths, linen, glass, iron, earthenware, and leather; and others are springing up all over the country. The internal commerce is of great importance, consisting principally of skins, furs, cattle, fish, both dry and salted, caviare, soap, and tallow. The transit trade between China and European Russia is also largely carried on across Siberia. The sole entrepot of this commerce was formerly at Kiakhta, S. E. of Lake Baikal, but trade is not now restricted to it. The principal exports to China are cotton and woollen cloths, linen, furs, gold and silver articles, and leather; the imports, tea, both leaf and compressed in cakes, sugar, silks, cottons, wool, cattle, leather, furs, grain, dried fruit, and colors. This trade has been chiefly carried on by means of the rivers which flow into Lake Baikal, thence through the Upper Tunguska to Yeniseisk, thence after a land carriage of about 40 m. passing through

the Ket, the Obi, and the Irtish to Tobolsk, whence there is again a land conveyance of about 500 m. across the Ural mountains to Perm. In winter it is maintained by means of sledges. But recently the tendency of the trade has appeared to be to take the sea route by the coast of China to Nikolayevsk, and thence up the Amoor by steamboat. There is also a considerable caravan trade with Ili, Tashkend, Khokan, &c. A great deal of the trade of the country is transacted at fairs held at stated periods. The most important fairs are at Obdorsk near the mouth of the Obi, Turukhansk on the Yenisei, Ustyansk on the Yana, Ostrovnoye on a tributary of the Kolyma, Tiumen on a W. tributary of the Irtish, and Irbit in the E. part of the government of Perm. During the summer steamers ply on all the large streams of central and southern Siberia and on Lake Baikal, so that there is less than 1,000 m. of wagon transit between St. Petersburg and the mouth of the Amoor. A great railway across the continent is projected, to connect European Russia with Peking. The proposed western terminus is Yekaterinburg on the E. slope of the Ural mountains, whence the line will pass through Shadrinsk, Omsk, Tomsk, and Krasnoyarsk to Irkutsk.—Siberia is divided into two military circumscriptions, East and West Siberia: the former comprises the governments of Irkutsk and Yeniseisk, and the provinces of Transbaikal, Yakutsk, Amoor, and the Littoral; the latter the governments of Tobolsk and Tomsk, together with the Kirghiz territories of central Asia. The respective capitals are Irkutsk and Omsk. Each of these two great divisions, which were formed on the present basis in 1865, has a military governor general, who is also commander-in-chief of the troops, and has control of all affairs, civil and military. Each of the governments and provinces has also a civil governor, subordinate to the governor general, who is assisted by a council of regency. A vice governor fills his place in case of his absence or sickness.—Genghis Khan conquered a part of Siberia, and his successors reduced the country lying on both sides of the Irtish. About 1580 the Russian family of Strogonoff, to whom the czar had granted lands on both sides of the Ural mountains, applied to a Cossack chief, Yermak Timofeyeff, for assistance against the khan Kutchum, who ruled the country on the Tobol and Irtish rivers. Yermak invaded the country and made extensive conquests. Other adventurers followed up his successes, which resulted in 1587 in the subjection to Russia of the khanate of Sibir (called after a town of that name, whence the name Siberia). Tobolsk, Tiumen, Pelymsk, and Berezov were soon after founded and settled by Europeans. In 1604 Tomsk was founded, and the Cossacks, pushing eastward, founded successively Kuznetsk, Yeniseisk, Irkutsk, Selenginsk, and Nertchinsk, and at last reached the shores of Behring strait. The conquest of the entire country was effected in about 80 years. The Amoor region was soon after visited by a Pole and some other exiles escaped from Yeniseisk, who built a small fort on the river; but having quarrelled with the Tunguses, they offered the conquest to the emperor of Russia, and begged forgiveness for their former offences, while the Tunguses about the same time applied to the emperor of China for assistance. This led to disputes between the two governments, but war was prevented, and the boundary between China and Siberia established, by a treaty concluded at Peking in 1689. A second treaty was made in 1727, confirming the former and confining commercial intercourse to Kiakhta and Maimatchin. The Amoor country was finally ceded to Russia in 1858, and in 1860 a treaty was concluded by which the whole line of the frontier was thrown open for traffic. The transportation of criminals to Siberia was begun by Peter the Great in 1710. A well organized insurrection of Polish exiles was promptly suppressed in 1866. In 1871 the Russians took possession of the whole of the island of Saghalien, which by a treaty concluded in 1867 had been divided between Russia and Japan, and in 1875 the Japanese government resigned all claims to it.—See Atkinson, "Oriental and Western Siberia" (London, 1858); Pumpelly, "Across America and Asia" (New York, 1870); and Kennan, "Tent Life in Siberia" (New York, 1870).

**SIBLEY**, a S. county of Minnesota, bounded S. E. by the Minnesota river; area, about 500 sq. m.; pop. in 1870, 6,725. The surface is undulating and the soil fertile. Lake Minnetonka, 30 m. long, is in this county. The chief productions in 1870 were 237,706 bushels of wheat, 142,060 of Indian corn, 221,416 of oats, 34,545 of barley, 32,659 tons of hay, 19,600 lbs. of wool, and 310,217 of butter. There were 1,726 horses, 3,531 milch cows, 5,952 other cattle, 3,666 sheep, and 3,990 swine. Capital, Henderson.

**SIBOUR, Marie Dominique Auguste**, a French prelate, born at St. Paul-Trois-Châteaux, Drôme, April 4, 1792, assassinated in Paris, Jan. 3, 1857. He was educated at Avignon and at Paris, was for a time professor in the seminary of St. Nicholas du Chardonnet in Paris, was next vicar to the parish of St. Sulpice and to the chapel of the *missions étrangères*, in 1822 became canon of the church of Nîmes, in 1838 vicar general of that diocese, in 1840 bishop of Digne, in 1848 archbishop of Paris, as successor to Affre, and in 1852 a senator. In 1857, while opening the yearly nine days' devotion in honor of St. Geneviève in the church of St. Étienne du Mont, he was stabbed to the heart by a priest named Verger, whom he had recently suspended. He was distinguished for religious and charitable activity, and published *Institutions diocésains* (2 vols., 1845).

**SIBYL** (Gr. σίβυλλα), a name applied to several women reputed prophetic in the ancient mythical period. Some authors say there

were four, others ten, viz.: the Babylonian, the Libyan, the Delphian, the Cimmerian, the Erythræan, the Samian, the Cumæan (sometimes identified with the Erythræan), the Hellespontian or Trojan, the Phrygian, and the Tiburtine. Counsel and help were sought from them under the belief that they were able to predict, to avert calamities, and to appease the gods. The most famous of all was the Cumæan sibyl, so called from Cumæ, her residence in Campania. According to an ancient Roman legend, she offered to sell Tarquinius Priscus nine books, which the king refused. Burning three, she offered the remaining six for the same price that she had asked for the nine; refused again, she burned three more, and still demanded the same price for the remaining three. The king purchased these, and the sibyl vanished. They were the famous sibylline books, and were preserved in the temple of Jupiter Capitolinus, in care of two officers (*duumviri*), afterward 10 (*decemviri*), and finally 15 (*quindecemviri*), who alone, directed by the senate, might inspect their contents. Of these nothing definite is known. The sibylline books having perished when the temple of Jupiter Capitolinus was burned in 83 B. C., a new collection was compiled by ambassadors sent to the various sibylline oracles in Italy, Greece, and Asia Minor, and was deposited in the new temple of Jupiter. In the reign of Augustus spurious prophetic books multiplied in private hands, and the emperor ordered 2,000 of them to be burned. Those volumes in custody of the state, revised by Tiberius, were preserved in two gilt chests in the temple of Apollo. Eight books of apocryphal Christian literature, collected after the 2d century, entitled "Sibylline Oracles," and still extant, consist of a heterogeneous mixture of heathen, Jewish, and Christian poems. An edition of these books was published by Gallæus in 1689 (4to, Amsterdam), and fragments have been edited by Angelo Mai (Milan, 1817) and Struve (Königsberg, 1818).

**SICARD, Roch Ambroise Cucurron**, abbé, a French philanthropist, born at Fousseret, near Toulouse, Sept. 20, 1742, died in Paris, May 10, 1822. He was educated at the university of Toulouse, entered holy orders, received instruction from the abbé de l'Épée, opened the school for deaf mutes at Bordeaux in 1786, and became vicar general of Condom and canon of Bordeaux. In 1789, on the death of De l'Épée, he was appointed his successor in the institution at Paris. His former church preferments caused him to be suspected, and on Aug. 26, 1792, he was imprisoned, and barely escaped death at the September massacre. His lectures attracted many of the more eminent literary men of Paris; but he incurred the wrath of the directory, and was banished for his strictures upon the government. He improved De l'Épée's method by the addition of signs for metaphysical ideas. In 1815 he visited England, taking with him his pupils Massieu and Clerc. He published several works on deaf-mute instruction. (See Deaf and Dumb, vol. v., p. 733.)

**SICILIES, The Two** (It., *Regno delle Due Sicilie*), formerly a kingdom of southern Italy, including the island of Sicily, with various smaller islands, and the kingdom of Naples. At the time of its incorporation with the dominions of Victor Emanuel in 1860, the area was 43,225 sq. m., and the population 8,703,130. It now forms six main divisions of the kingdom of Italy, viz.: the island of Sicily, with seven provinces (see Sicily), and the continental divisions of Abruzzo and Molise, Campania (with Naples), Apulia, Basilicata, and Calabria, with an aggregate of 16 provinces (including Benevento, which formerly belonged to the papal dominions) and somewhat over one third of the population of all Italy. (See Italy.)—The early history of the peninsular part of the country, which in ancient times comprised the divisions of Bruttium, Lucania, Calabria, Apulia, Samnium, Campania, and a part of Latium, is closely connected with the history of Rome, and, through the Magna Græcian cities of Tarentum, Croton, Sybaris, Thurii, Rhegium, Neapolis, and others, partly also with that of Greece. After the fall of the western empire the country was successively under the power of the Goths, the Byzantine exarchate of Ravenna, and the Saracens; but several small republics or duchies, as Naples, Salerno, Amalfi, Gaëta, and Benevento, ultimately rose to independence. During the first half of the 11th century great numbers of Norman adventurers served these small states as mercenaries, but soon began to wage war on their own account; and under the leadership of William Bras de Fer, Drogo, and Robert Guiscard, they conquered the greater part of Apulia, which they divided into 12 counties, forming together a feudal confederation. In 1053 Pope Leo IX., at the head of German and Italian troops, tried to expel the new conquerors; but he was defeated at Civitella and taken prisoner, and his captors obliged him to recognize their conquests by formally holding them as vassals of the holy see. Robert Guiscard established his power paramount over his companions in arms, assumed the title of duke of Apulia, and subdued Calabria, while his youngest brother Roger made himself master of the island of Sicily, previously occupied by the Saracens. In 1127 the whole of the Norman acquisitions were united under Roger II., son of Roger I., the conqueror of Sicily, who received in 1130, from the antipope Anacletus II., the title of king of Sicily and Apulia. The bull which conferred that dignity clearly established the paramount lordship of the pope, and stipulated the annual tribute to be paid by the new kingdom. Roger conquered Capua and Naples. He was succeeded in 1154 by his son William I. the Bad, who left his crown to William II. the Good (1166-'89);

the latter promoted public prosperity, and was a stanch supporter of Pope Alexander III. and the cities of Lombardy against the emperor Frederick Barbarossa. William II. died without issue, and his kingdom was claimed by his aunt Constantia, who had married the son of Frederick Barbarossa. Her husband, Henry VI., upheld her rights against the usurper Tancred, and finally in 1194 united the kingdom of Naples and Sicily to the empire. On his premature death in 1197, his Italian crown passed to his son, afterward the emperor Frederick II. The exertions of this prince to annihilate the Lombard league and to strengthen his dominion over Italy drew upon himself and his descendants the persecution of the papal court; and during the minority of Conradin, his grandson, the Roman see took the kingdom. Manfred, a natural son of Frederick II., at first regent for his nephew Conradin, then king on the pretended death of this young prince (1258), was finally defeated and slain at the battle of Benevento (Feb. 26, 1266), by Charles of Anjou, who had been crowned as his successor by Pope Clement IV., and who now usurped the power in the two kingdoms. Conradin, the last of the Hohenstaufen, was utterly defeated at Tagliacozzo, Aug. 23, 1268, and beheaded at Naples, Oct. 29. The exasperation produced by Charles's despotism finally culminated (March 30, 1282, at the hour of vespers) in the revolt and massacre at Palermo provoked by the licentious brutality of a Frenchman, and the expulsion of the French from Sicily, an event known as "the Sicilian vespers," and Pedro III. of Aragon, the husband of Constantia, Manfred's daughter, became king. Charles strove in vain to regain possession of Sicily. For more than a century and a half the island (mainly ruled by a younger branch of the house of Aragon) and the continental kingdom were separated from each other, and the sovereigns of both parts styled themselves kings of Sicily. The destinies of the house of Anjou at Naples, obscured during the later years of Charles I. and the reign of his son Charles II. the Lame, brightened again under Robert the Wise (1309–'43), the patron of Petrarch; but the reign of his granddaughter, Joanna I., was marked by all sorts of domestic crimes and disorders. After her execution by order of the king of Hungary (see JOANNA) in 1382, a bloody contest raged between Louis I., the head of the second house of Anjou, her adopted son, and Charles of Durazzo, her lawful heir. The latter finally triumphed, but was called to Hungary by discontented nobles in 1385, crowned king, and murdered soon after. His son Ladislas, scarcely 10 years old, was overthrown by the Angevine party, who called in Louis II. of Anjou in 1389; but in 1399 he reascended his throne, and crushed the adherents of his rival. He was succeeded in 1414 by his sister Joanna II., whose reign of 21 years was as shameful and disastrous as that of Joanna I. After adopting in succession Alfonso V. of Aragon and Louis III. of Anjou, she finally, on the latter's death, bequeathed the crown to his brother René. After a few years' war René was expelled by Alfonso V., who received the investiture of his new kingdom from Pope Eugenius IV., and thus reunited the two parts of the old monarchy. On his death in 1458 he left the kingdom of Naples to his natural son Ferdinand I., who finally maintained his rights against John of Calabria, son of King René, while Sicily as well as Aragon fell to his brother John II. In 1494 the kingdom of Naples was suddenly conquered by Charles VIII. of France, and its possession was disputed by the French and Spaniards until Ferdinand the Catholic became master of it in 1503, and was successively known as Ferdinand III. of Naples and Ferdinand II. of Sicily. The oppressive rule of the Spanish viceroys resulted in 1647 in the rising under Masaniello at Naples, and in other commotions; the disturbances created by the former lasted for years, though Masaniello was speedily assassinated (July 16, 1647). During the war for the Spanish succession the people sided with Philip V., the Bourbon king; but in 1707 they accepted his competitor Charles of Austria, afterward emperor of Germany as Charles VI., whose title to Naples was confirmed by the treaty of Utrecht in 1713, while Sicily was given to Victor Amadeus of Savoy. The latter exchanged Sicily in 1720 for Sardinia, and the two kingdoms remained under the rule of Charles VI. till 1734, when they were conquered by Don Carlos, son of Philip V. of Spain, who was crowned at Palermo in 1735 as Charles III., and acknowledged as king of the Two Sicilies. In 1759, on his succession to the throne of Spain, his son Ferdinand IV. became king of Naples and Sicily. Under the influence of his wife Queen Caroline and her favorite the prime minister Acton, he joined the first coalition against France, and in 1799 the French established the Parthenopean republic in the Neapolitan territory. This was overthrown after a few months, and Ferdinand restored. He retained the island of Sicily with the assistance of England, but after his violation of the treaty of Paris which in 1801 he had concluded with France, Napoleon deposed the Bourbons, and in 1806 gave the throne of Naples to his brother Joseph, and in 1808 to Murat. In 1815, after the overthrow of Murat, Ferdinand was restored; and on Dec. 12, 1816, he assumed power over the two countries as Ferdinand I. of the (united) kingdom of the Two Sicilies. He abrogated the constitution which he had granted while in Sicily. The rising under Pepe in 1820 obliged him to adopt the Spanish liberal constitution of 1812, but with the aid of Austria he soon suppressed it. On his death, Jan. 4, 1825, he was succeeded by his son Francis I., who had become popular by his liberalism, but whose reign was notorious for his subserviency to Austria. He died in 1830.

His son and successor, Ferdinand II. (1830–'59), was the most odious of all the Bourbon rulers from his sanguinary repression of insurrections in Sicily and Naples. His excesses aroused the national spirit and paved the way for liberty. His son Francis II. adhered to his despotic system. In 1860 Garibaldi invaded Sicily, conquered it, and crossed the strait of Messina. On his approach in September toward Naples Francis fled to Capua. There he rallied an army, which was however compelled to surrender with the fortress, Nov. 2, the court retiring to Gaëta. The two kingdoms were merged with Victor Emanuel's possessions, and the flight of Francis from Gaëta and the surrender of that stronghold to Gen. Cialdini, Feb. 13, 1861, removed the last obstacles to national unity, and Victor Emanuel received on Feb. 26 the title of king of Italy.—See Giannone, *Storia civile del regno di Napoli* (4 vols., Naples, 1723; new ed., 13 vols., Milan, 1823 *et seq.*); Colletta, *Storia del reame di Napoli dal* 1734 *sino al* 1825 (2 vols., Capolago, 1834; English translation, 1858); and Reuchlin, *Geschichte Neapels während der letzten siebzig Jahre* (Nördlingen, 1862).

**SICILY** (anc. *Trinacria*, from its triangular shape, *Sicania*, and *Sicilia*), the largest island of the Mediterranean, forming part of the kingdom of Italy, separated from Calabria by the strait of Messina, between lat. 36° 38′ and 38° 18′ N., and lon. 12° 25′ and 15° 40′ E. The northern side is 180, the southwestern 171, and the eastern 113 m. long; area, 11,291 sq. m.; pop. in 1872, 2,584,099. The extreme points of the island are Capo di Faro or Cape Peloro (anc. *Pelorus*) at the northeast, Cape Passaro (*Pachynus*) at the southeast, and Cape Boeo (*Lilybæum*) at the northwest. It is divided into the provinces of Caltanisetta, Catania, Girgenti, Messina, Palermo, Syracuse, and Trapani. Capital, Palermo. The coast has numerous indentations, the largest of which are the gulf of Castellamare on the northwest, the gulf of Patti on the northeast, and the bay of Catania on the east; the best harbors are those of Palermo, Messina, Agosta, and Syracuse. The tides on the coast are slight and irregular. Of the two principal currents of the Mediterranean, that from the Atlantic and that from the Black sea, only the first is felt upon the shores of Sicily, and in its set through the strait of Messina it causes the whirlpool at the N. end called by the ancients Charybdis. Most of the mountains of Sicily are regarded as part of the system of the Apennines. The northern part of the island is generally high, the mountains in several places coming close to the sea; but in the opposite direction they recede to a considerable distance, and the coasts are of moderate elevation. The celebrated volcano Mt. Etna rises in solitary grandeur (upward of 10,800 ft.) from the E. coast, midway between the N. and S. extremities of the island. (See Etna.) A range of mountains runs from Cape Peloro, on the strait of Messina, to the S. W., following the E. coast to near Taormina, 30 m. from Messina, where it is joined by a chain from the west which keeps much nearer the N. than the S. W. shore, and sends off spurs to the coast in the former direction. The first chain, now called Pelorian, was anciently known as Neptunius Mons; the second is now called Madonian, and was anciently known as the Nebrodian. No part of this chain rises above 6,300 ft., and in the west it becomes much broken. About half way across the island a chain of great hills breaks off from the Madonian mountains, runs W. of the high plateau of Etna to the southeast, and is cut up by numerous and precipitous ravines, but sinks into a flat country as it approaches the S. E. point of Sicily. The island is watered by numerous streams, the most important of which are the Alcantara (anc. *Taurominius*) and Giaretta or Simeto (*Symæthus*) on the E. coast, the Salso (S. *Himera*), Platani (*Halycus*), and Belici (*Hypsas*) on the S. W., and the Termini (N. *Himera*) on the N. They are nearly all mere torrents, dry or nearly so in summer, but swelling into floods during the seasons of heavy rains; and few of them are navigable even at their mouths. The largest lake is that of Lentini, near the E. coast, between Catania and Syracuse; it is about 12 m. in circumference, but shallow and stagnant.—Sicily contains no strata corresponding to those of the Silurian, the old red sandstone, the carboniferous, or the new red sandstone formation; granite and limestone are found in some places, and near Etna a large tract is covered with volcanic products. Different kinds of fine stone abound, and amber is procured near Catania. Small quantities of argentiferous lead, quicksilver, iron, copper, and antimony are found, but they are seldom worked. The other minerals include marble, petroleum, emery, alum, rock salt, agates, and sulphur, the most important of all. The climate is temperate and agreeable. The thermometer rarely rises higher than 92° F. and seldom sinks below 36°, and the mean annual temperature at Palermo is about 64°. The annual fall of rain is about 26 inches, nearly all during the winter months. In summer the weather is settled, but after the autumnal equinox it becomes for a time hazy and boisterous. Thunder storms are violent and frequent; and the sirocco, or S. E. wind, blowing for three or four days at a time, is very distressing in some parts of the island. There are two kinds of level ground in Sicily. Of the first an example is found in the dreary wastes along the S. shore, where the limestone rock coming near the surface supports a scanty vegetation; and of the second in the fertile plains of Palermo, Catania, and Castellamare, filling up the curves of the mountains which recede from the sea. The hilly regions are varied with undulating slopes and bold crags, the former of which are clothed with forests of fine timber, or covered with excellent pastures. In the fertile plains cultivation is general, and

although the mode is rude and careless, the crops are often remarkable for their luxuriance; the most important are wheat, maize, barley, and pulse. Artificial grasses are grown to a small extent, and hemp is raised in the deeper and lower grounds. The vine and olive are extensively cultivated, and often intermixed. The other productions include sugar, barilla, cotton, sumach, saffron, manna obtained from a species of ash (*fraxinus ornus*), and the mulberry, which is extensively applied to rearing silkworms. Various kinds of fruit abound. The most valuable kinds of timber are ash, oak, pine, elm, and chestnut. Cattle are not numerous, and are generally neglected. Sheep are extensively reared, but the breed is inferior, and in many places goats are preferred to them. Snakes are common in the plains, and wolves in the mountains.—The population is a mixture of many races, but the Sicanians or Siculians seem to have been the aborigines. Greeks, Carthaginians, Romans, Vandals, Goths, Herulians, Arabs, and Normans afterward settled among them. The Sicilians are of light olive complexion, middle stature, and well made. The dialect differs considerably from the Italian, being much mixed with Arabic and other languages. They are all Roman Catholics, excepting a number of descendants of modern Greek settlers, who adhere to the Greek church. The unequal distribution of landed property, the fatal rule of the Bourbons, the total neglect of education, and other untoward circumstances have produced great misery in Sicily; but the island is gradually improving under Victor Emanuel, although brigandage still prevails, especially under a wide-spread organization known as the *Mafia*. There are now elementary schools in the villages and higher schools in the towns, and Palermo has a celebrated university. Industry is not much developed, and the manufactures are limited chiefly to the larger towns. The wines of the country are largely exported, along with fruit, grain, oil, sulphur, silk, wool, sumach, &c. The fisheries are among the most productive in the Mediterranean.—The first inhabitants of Sicily are supposed to have come from the continent of Italy. The Phœnicians early founded colonies there, including Panormus (now Palermo) and Eryx. In the 8th century B. C. the Greeks drove them into the interior, and in that and the following two centuries established several colonies on the coasts, such as Zancle or Messana (Messina), Syracuse, Leontini (Lentini), Catana (Catania), several towns called Hybla, Gela, Selinus, and Agrigentum (Girgenti), of which Syracuse and Messana became the most celebrated. The Carthaginians invaded the island early in the 5th century and also established colonies, which, after long contests with the Greeks, finally fell under the power of Syracuse. (See SYRACUSE.) During the first Punic war Agrigentum was the principal stronghold of the Carthaginians, but was conquered by the Romans, who subsequently obtained possession of the whole island, afterward their principal granary. On the decline of the Roman empire Sicily was overrun by barbarians. The Ostrogoths, who conquered it at the close of the 5th century, were expelled in 535 by the Byzantine general Belisarius. The Saracens occupied it about 830, and made Palermo their capital. In the 11th century they were driven out by the Normans, who established the feudal system, and united Sicily to Naples, with which its subsequent history is identified. (See SICILIES, THE TWO.)—Among recent works on Sicily are: *L'Histoire de la Sicile sous la domination des Normands*, by Bazancourt (2 vols., Paris, 1846); *Storia dei Musulmani di Sicilia*, by Amari (Florence, 1853); *Compendio della storia di Sicilia*, by San Filippo (7th ed., Palermo, 1859); *Neapel und Sicilien*, by Löher (2 vols., Munich, 1864); *Siciliana*, by Gregorovius, included in his *Wanderjahre in Italien* (4 vols., Leipsic, 1874); "History of Sicily to the Athenian War," by W. Watkiss Lloyd (London, 1874); and *Geschichte Siciliens im Alterthum*, by Ad. Holms (3 vols., Leipsic, 1874 *et seq.*).

**SICKINGEN, Franz von**, a German soldier, born in the castle of Sickingen, Baden, March 1, 1481, died May 7, 1523. He was rich and distinguished for valor and generosity. He encouraged the reformation, protected Reuchlin and Ulrich von Hutten, and offered an asylum to Luther. In 1513 he declared war against the city of Worms, and subsequently fought against the duke of Lorraine, levied large amounts of money upon Metz and other cities, and laid siege to Mentz, when the quarrel was adjusted by the emperor. In 1521 he invaded Picardy with the count of Nassau, but was forced by a stratagem of the chevalier Bayard, and by sickness in his army, to abandon the expedition. In 1522 a private dispute brought him into war with the archbishop of Treves, and he raised an army of 12,000 men and desolated his territories. In 1523 he was besieged in his castle Landstuhl near Kaiserslautern, and surrendered after receiving a mortal wound. He was one of the last nobles who maintained in Germany the right of private warfare. His descendants became counts of the empire; only one branch of them now survives.—See *Ritter Franz von Sickingen und seine Nachkommen*, by Schneegans (Creuznach, 1867).

**SICKLE.** See SCYTHE.

**SICKLE-BILL.** See CURLEW.

**SICKLES, Daniel Ephraim**, an American general, born in New York, Oct. 20, 1822. He studied at the university of New York, but did not graduate, and was admitted to the bar in 1844. In 1847 he was elected to the state legislature, and in 1853 was appointed corporation attorney in New York city. In the latter year he accompanied Mr. Buchanan to England as secretary of legation. He was elected to the state senate in 1855 and to congress in 1856, and re-elected to the latter in 1858 and 1860. In 1859 he shot Philip Barton Key in Washington for

an intrigue with his wife, and was tried for murder, but acquitted. On the outbreak of the civil war in 1861 he raised the Excelsior brigade in New York, and was commissioned colonel. In September his nomination as a brigadier general of volunteers was rejected by the senate, but on its renewal was confirmed; and in the battles of the Chickahominy campaign he commanded a brigade of Hooker's division of the 3d corps. He succeeded Hooker in the command of his division, which he led in the battles of Antietam and Fredericksburg. He was commissioned a major general of volunteers Nov. 29, 1862, and commanded the 3d corps at Chancellorsville, May 2–4, 1863, and at Gettysburg, July 2, where he lost a leg. He was appointed colonel of the 42d infantry regiment of the regular army, July 28, 1866, and was commander of the second military district (North and South Carolina) till Aug. 26, 1867. In 1869 he was appointed minister to Spain, which office he resigned in 1874. He married a Spanish lady as his second wife.

**SICYON** (now *Vasilika*), one of the most ancient cities of Greece, in the Peloponnesus, originally on a plain near the Corinthian gulf. Having been destroyed, it was rebuilt by Demetrius Poliorcetes on a hill between the Asopus and Helisson, about 10 m. N. W. of Corinth. The streets, laid out at right angles, are still traceable. Its territory was called Sicyonia. It was one of the Dorian states, and was ruled by tyrants for about a century after 676 B. C. It joined the Persians in their wars, was repeatedly assailed by the Athenians, and favored the Spartans in the Peloponnesian conflict. Aratus, its general, united it to the Achæan league in 251. It was long a chief seat of Grecian art, and had an eminent school, founded by Eupompus and including Apelles and Pamphilus, and was the model of taste and fashion in dress for all Greece.

**SIDDONS, Sarah,** an English actress, born in Brecknock, South Wales, July 5, 1755, died in London, June 8, 1831. The eldest of the children of Roger Kemble (see KEMBLE), at 13 years of age she took principal parts in English operas. At 18 she married Mr. Siddons, a young actor in the Kemble company. She first appeared at Drury Lane theatre Dec. 29, 1775, as Portia in the "Merchant of Venice," but failed to produce a decided impression, apparently in great part from timidity, and at the close of the season was dismissed. She devoted herself anew to study, and, after great successes at various provincial theatres, was solicited to reappear at Drury Lane. On Oct. 10, 1782, she began this second engagement as Isabella in "The Fatal Marriage," producing a profound sensation. At once she stood at the head of the British stage, and so continued till her retirement from professional life, June 29, 1812. On this occasion she played Lady Macbeth, and the moment the night scene was over the audience rose and demanded that the play should close. Mrs. Siddons was of medium height, symmetrical and majestic, with corresponding voice and expression. Her countenance was of extraordinary flexibility. Her genius at first inclined to pathetic characters, as Isabella, Ophelia, Jane Shore, Belvidera, or Euphrasia, but later to those of power and majesty. In some other rôles she was but moderately successful. Her private character was highly esteemed.

**SIDEREAL TIME.** See DAY.

**SIDI MOHAMMED,** emperor of Morocco, born in 1803, died Sept. 20, 1873. He succeeded to the throne in 1859, as the elder son of Abderrahman, and soon afterward was engaged in difficulties with France and in a serious war with Spain, on account of the depredations of the Rif pirates. The Spanish forces under Prim and O'Donnell achieved signal victories, and the final treaty of April 27, 1860, bound the emperor to pay an indemnity to Spain of 20,000,000 piasters, and to cede her some territory, besides granting her other concessions. He afterward strove to secure the good will of Christian powers by introducing reforms and making concessions to foreigners, which produced such discontent among his subjects that they nearly drove him from the throne in 1862. Yet in 1864 he granted liberty of commerce to all European traders in his dominions, and the result was repeated insurrections. That of 1867, the most formidable, he quelled by attacking the insurgents in person at the head of a powerful army. He was succeeded by his son Muley Hassan.

**SIDMOUTH, Lord.** See ADDINGTON.

**SIDNEY, Algernon,** an English statesman, born about 1622, executed on Tower hill, London, Dec. 7, 1683. He was the second surviving son of the second earl of Leicester of that creation, by the eldest daughter of the earl of Northumberland, and grandnephew of Sir Philip Sidney. In 1632 he accompanied his father to Denmark, where the latter was accredited as ambassador, and four years later to France. In 1641 he served in Ireland as captain of a troop of horse in a regiment commanded by his father; and at the outbreak of the civil war, while on his way with his brother to join the king's forces, he was detained at Liverpool by order of parliament. The king believed this had been done through the connivance of the young men, who, resenting his distrust, at once declared for the parliament. Algernon Sidney was commissioned a captain in May, 1644, and fought with gallantry at Marston Moor, where he was severely wounded. In 1646 he was appointed lieutenant general of horse in Ireland, and governor of Dublin. In the same year he entered parliament for Cardiff, and in May, 1647, received the thanks of parliament for his services in Ireland, and was made governor of Dover castle. He acted as one of the judges of the king, but refrained from signing the warrant for his execution, although he subsequently characterized it as "the justest and bravest action that ever was

done in England or anywhere else." His opposition to the protectorship of Cromwell compelled him to relinquish his legislative duties; and in April, 1653, he retired to his father's residence at Penshurst. He resumed his seat at the first meeting of the restored parliament in 1659, and on May 13 was nominated one of the council of state. On June 5 he was sent as one of the commissioners to negotiate a peace between Sweden and Denmark, and was absent from England at the time of the restoration. Unwilling to return to his native country while it remained under "the government of a single person, kingship, or house of lords," he remained a voluntary exile for nearly 18 years. Intent upon establishing an English republic, in 1665 he sought the assistance of the Dutch government and the influence of the French ministers toward that end. Failing in both instances, he retired to the south of France, where he lived till 1677, when, at the solicitation of his father (a centenarian), a permission for him to return home was obtained from the king. He soon became an active opponent of the court, but was defeated in two attempts to obtain a seat in parliament. He is charged with accepting 500 guineas for favoring the intrigues of Barillon, the French ambassador, who about this time was in clandestine correspondence with prominent members of the popular party seeking to crush the duke of York and the Roman Catholics, the parliament, and the ministry. But it has been alleged that, if true, the act was not criminal, as it required no betrayal of his principles, and as he needed the money and its acceptance was not repugnant to the practice of the age. The discovery of the Rye House plot, in June, 1683, gave the king an opportunity to exact vengeance for years of restraint and humiliation; and Sidney, with his illustrious companion in misfortune, William Lord Russell, was arrested on a charge of complicity with the conspirators, and imprisoned in the tower. At his trial, over which Jeffreys presided, but a single living legal witness to the conspiracy for an insurrection, the infamous Lord Howard, could be produced; but garbled extracts from a theoretical work on government in manuscript, which had been found among Sidney's papers, were read in evidence against him. These, though containing assertions of the right of a people to depose an unworthy sovereign, were unconnected by other evidence with the conspiracy itself; under the ruling of the court, they were nevertheless deemed sufficient to convict. Sidney met his death "with the fortitude of a stoic." His attainder was reversed by the first parliament of William and Mary. His "Discourses concerning Government" were published in 1698, and a fourth edition, with additions by Thomas Hollis, including his "Apology," dated on the day of his death, and a number of letters and miscellaneous pieces, in 1772. His "Essay on Virtuous Love" was published in vol. viii. of the Somers collection of tracts (1742). The fragmentary distich,

> . . . manus hæc inimica tyrannis
> Ense petit placidam sub libertate quietem,

which he wrote in the university album at Copenhagen, is perhaps the best remembered extract from his writings. The report of his trial, after Jeffreys had struck out whatever he pleased, was published in 1684; it is also given in "Howell's State Trials."—His life has been written by George Wilson Meadley (8vo, London, 1813), and by G. Van Santvoord (12mo, New York, 1851). See also Arthur Collins, "Memoirs of the Lives and Actions of the Sidneys," prefixed to his "Letters and Memorials of State," &c. (2 vols. fol., London, 1746), and Blencowe, "Sydney Papers" (8vo, 1825).

**SIDNEY**, or **Sydney**, Sir **Philip**, an English author, born at Penshurst, Kent, Nov. 29, 1554, died in Arnhem, Holland, Oct. 7, 1586. His father, a descendant of Sir William Sidney, chamberlain to Henry II., was in his youth the bosom friend of Edward VI., and during the reign of Elizabeth held for many years the office of lord deputy of Ireland. His mother was the eldest daughter of the ambitious and unfortunate John Dudley, duke of Northumberland, and sister of Robert Dudley, earl of Leicester. At the age of 12 Sidney was sent to the grammar school of Shrewsbury, and in 1569 entered Christ Church college, Oxford. He subsequently studied at Cambridge, and at both universities was distinguished not less for preëminence in manly exercises than in mental accomplishments. In May, 1572, he obtained a license from the queen "to go out of England into parts beyond the seas," in order to perfect his knowledge of the continental tongues. At the court of Charles IX. of France he attracted the attention of the king, who appointed him gentleman in ordinary of his chamber; but the spectacle of the St. Bartholomew massacre induced him to depart abruptly from Paris, and he travelled through Germany, Italy, Hungary, Poland (where he took some part in the skirmishes with the Russians), and the Low Countries. Returning to England at the expiration of three years, he at once took his place among the foremost of the accomplished Englishmen of the time. The queen showed him special favor, and called him "her Philip," in opposition, it is supposed, to Philip of Spain, her sister Mary's husband. In 1576 he was nominated ambassador to Vienna, ostensibly to condole with the emperor Rudolph on the demise of his father, Maximilian II., but with the secret instruction to cement an alliance of the Protestant states against Spain; a mission which he discharged successfully, gaining the esteem and high praise of the prince of Orange. He returned in 1577, and for the next few years was employed in no important public capacity, partly from his reluctance to give up his literary

occupations, and partly, it has been suggested, through the machinations of Lord Burleigh. But he defended successfully the character of his father, whose administration in Ireland had been misrepresented by enemies at court. When admonished by the queen, in consequence of a dispute between himself and the earl of Oxford, of the difference in degree between earls and gentlemen, he replied that, "although Oxford was a great lord by birth, alliance, and grace, yet he was no lord over him; and therefore the difference of degrees between freemen could not challenge any other homage than precedency." Although the answer was taken in good part by the queen, Sidney deemed it prudent to retire for a while from court; and while residing at the seat of his sister, the countess of Pembroke, he wrote his pastoral romance of "Arcadia," which is in prose, interspersed with short poems. It never received the finishing touches and corrections of the author, and was moreover left incomplete. After circulating in manuscript for several years, it was published by the countess of Pembroke in 1590; and such was its popularity, that previous to the middle of the 17th century upward of ten editions had appeared, and a French translation was published in 1624. To this period also probably belong the "Defence of Poesie," published in 1595, and originally designed as an answer to the attacks of the Puritans, and the series of amatory poems entitled "Astrophel and Stella" (1591), which recount the author's passion for Lady Rich, sister of Lord Essex, to whom he was at one time betrothed. In the intervals of his literary occupations he participated in courtly pageants and jousts, the most conspicuous of all the brilliant circle who surrounded the throne; and in 1583 he married the daughter of Sir Francis Walsingham, and was knighted. In 1585 he was nominated governor of Flushing, and in the latter part of the year appointed general of horse under his uncle the earl of Leicester, who was sent with a body of English troops to aid the Dutch in their war of independence. Sidney was fast building up a reputation as a skilful general when his career was brought to an untimely close. On Sept. 22, 1586, a small detachment of English troops under his command unexpectedly encountered 3,000 Spaniards who were marching to the relief of Zutphen, and a desperate engagement was fought under the walls of the fortress, in which the enemy were signally defeated. Sidney, seeing the Spanish leader going into battle lightly armed, was induced by a chivalric spirit of emulation to imitate his example; and after a series of gallant charges, in which he had a horse killed under him, he received a musket ball in his left thigh. While leaving the field, "being thirsty with excess of bleeding," says Lord Brooke, "he called for drink, which was presently brought him; but as he was putting the bottle to his mouth, he saw a poor soldier carried along, who had eaten his last at the same feast, ghastly casting up his eyes at the bottle. Which Sir Philip perceiving, took it from his head before he drank, and delivered it to the poor man, with these words: 'Thy necessity is yet greater than mine.'" He lingered several weeks in great agony, and met his death with Christian serenity, solacing even his last hours with literary composition. His body was taken to London, and after lying in state was interred in St. Paul's cathedral, Feb. 16, 1587; and a general mourning, the first on record in England, was observed. Spenser has embalmed their mutual friendship in a pastoral ode entitled "Astrophel." Sidney left an only daughter, who became fifth countess of Rutland, but died without issue; and his name is now represented in the English peerage by Lord De l'Isle, a descendant of his brother Robert. His "Complete Works" were published in 3 vols. 8vo (London, 1725), and his "Miscellaneous Works" were edited with a memoir by W. Gray (Oxford, 1829; reprinted, Boston, 1860). The latest edition of his works is "The Complete Poems of Sir Philip Sidney," edited by the Rev. A. Grosart, in the "Fuller Worthies' Library," printed for private circulation (2 vols., 1873).—His sister MARY, countess of Pembroke (died Sept. 25, 1621), is intimately connected with his private history. He joined with her in a translation of the Psalter "into sundry kinds of verse," first printed in London in 1823. She wrote an elegy on her brother, a pastoral poem in praise of Astræa (Elizabeth), and a poem "On our Saviour's Passion," preserved in manuscript in the British museum, and published in 1862, besides translating from the French the "Tragedy of Antonie."

**SIDON**, or **Zidon** (Heb. *Tzidon*, fishery; now *Saida*), an ancient city of Phœnicia, on the coast, 23 m. N. of Tyre. According to Josephus, it was called Sidon after the first born of Canaan, but the name probably has reference to the first occupation of its inhabitants. From its antiquity it was termed the metropolis of Phœnicia. It seems to have been divided into Great Sidon, on the sea, and Little Sidon, some distance inland. The Phœnicians as a nation often designated themselves as Sidonians, and were generally called so by neighboring peoples. The period of the greatest prosperity of Sidon, according to the classical historians, was from about 1600 to 1200 B. C., during which time, as appears from the Egyptian inscriptions, it was more or less under the supremacy of Egypt. At the time of the Hebrew conquest of Palestine, the rule of Sidon extended over the N. W. part of that country. The ancient history of the town is in a measure that of the whole of Phœnicia, at least until the commencement of the supremacy of Tyre. (See PHŒNICIA, and TYRE.) It flourished under the Persians, but was destroyed in 351 B. C., as a punishment for rebelling against Artaxerxes III. Ochus. It was thenceforth a provincial capital, but retained its own

local government until the time of Roman supremacy. Christianity early found an asylum here (Acts xxvii. 3), and a Sidonian bishop is mentioned as present at the Nicæan council of 325. On the rise of Moslem power it readily submitted to it. In 1108 it was invested by the crusaders, and in 1110 it was taken by Baldwin I. The Saracens captured it in 1187, but the Christians recovered it in 1197. They abandoned it in 1291, and Sultan Malek Ashraf ordered it to be razed. (See SAIDA.)

**SIDONIUS APOLLINARIS, Caius Sollius Modestus,** a Latin author and saint, born probably in Lyons about A. D. 431, died at Clermont in Auvergne, in 482 or 484. He was a diligent student, and early acquired a high reputation. He married a daughter of Flavius Avitus, afterward emperor, accompanied him to Rome in 456, and pronounced his panegyric in verse before the senate, for which that body erected a bronze statue in his honor. He was prefect of Rome when Avitus was dethroned by Majorian. Sidonius pronounced at Lyons a public panegyric on the latter, by whom he was created a count and sent to govern the Gallic province of Arles. In 467 he went to Rome as ambassador of the Arverni, delivered a panegyric on the reigning emperor Anthemius, was made a patrician, and governor of the city a second time, and was honored with a second statue. In 472 he was elected bishop of Clermont (Arvernum), though only a layman, accepted the office reluctantly, fulfilled its duties faithfully, and strenuously opposed the spread of Arianism. He left nine books of epistles of considerable historical interest, which, with his poems and panegyrics, were published in Milan in 1498 by Sirmond (Paris, 1614; republished by Labbe in 1652, the best edition), and by Migne in vol. lviii. of his *Patrologie latine.*—See *Saint Sidoine Appollinaire et son siècle,* by Chaix (2 vols., Clermont-Ferrand, 1867–'8).

**SIDRA, Gulf of.** See SYRTIS.

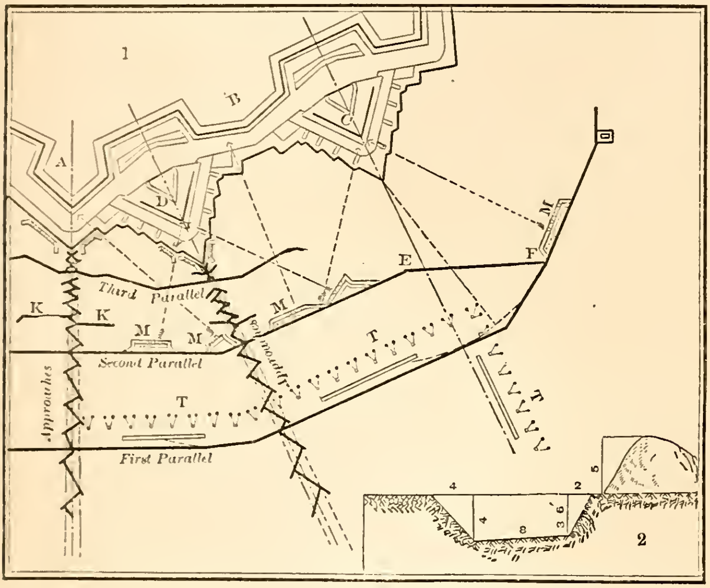
**SIEBOLD. I. Philipp Franz von,** a German traveller, born in Würzburg, Feb. 17, 1796, died in Munich, Oct. 18, 1866. He studied medicine, natural sciences, and geography, and in 1822 went to Batavia as a physician and naturalist in the Dutch service, and in 1823 to Japan as a member of the Dutch embassy. In 1826 he went to Yedo, and was involved in difficulties with the Japanese for procuring an official map of their country. Finally acquitted, he returned to Europe in 1830, but from 1859 to 1862 resided again in Japan. He published *Nippon, Archiv zur Beschreibung von Japan* (20 vols., Leyden, 1832–'57); *Fauna Japonica* (jointly with Temminck and others, 1833 *et seq.*); *Flora Japonica* (1835 *et seq.*); *Bibliotheca Japonica* (jointly with J. Hoffmann, 6 vols., 1833–'41); and several other works on Japan. **II. Karl Theodor Ernst von,** a German physiologist, brother of the preceding, born in Würzburg, Feb. 16, 1804. After teaching in various places, he became in 1853 professor of physiology, comparative anatomy, and afterward also of zoölogy, at Munich. His principal works are *Lehrbuch der vergleichenden Anatomie der wirbellosen Thiere* (Berlin, 1848; English translation, London, 1854), and *Beiträge zur Parthenogenesis der Arthropoden* (1871).

**SIEDLCE. I.** A W. government of Russia, in the kingdom of Poland, bordering on the governments of Lomza, Warsaw, Radom, Lublin, Volhynia, and Grodno; area, 5,534 sq. m.; pop. in 1872, 543,392. It is level and fertile. The chief river is the Bug, which forms the E. and N. E. frontier. The principal towns are Siedlce, Miendzyrzecz, and Wlodawa. The government embraces the principal portions of the former palatinate of Podlachia. The more ancient Polish territory of the same name, however, lay mainly between the middle Bug and the Niemen. **II.** A town, capital of the government, 51 m. E. S. E. of Warsaw, with which it is connected by rail; pop. in 1867, 10,013. It has a fine palace and town hall, distilleries, sugar refineries, and manufactories of agricultural implements. During the wars between the Russians and Poles it was repeatedly taken and retaken.

**SIEGE** (Fr. *siége*, seat), a protracted military attack upon a fortified place. Such a place may sometimes be taken by throwing in heavy projectiles, explosive shells, incendiary balls, &c.; or by completely surrounding it, preventing reception of supplies, the defenders may be compelled to surrender; or, advancing by regular approaches, the besiegers may breach the walls, and carry the place by assault. The first is called a bombardment, the second a blockade, and the third a siege, which term is often also applied to the other two. In a strict sense, the term siege signifies the process of advancing toward a fortified place under cover of earth thrown up from trenches, silencing the fire from the work by a superior one, and breaching the ramparts, compelling a surrender or carrying the place by assault. Sieges are divided into ancient and modern, or those carried on before and after the application of gunpowder to military purposes.—*Ancient Sieges.* The ancients fortified a place by surrounding it with a wall of brick or stone, forming a continuous line around the city or town, high enough to render escalade difficult, and thick enough to offer considerable resistance to the battering ram. Sometimes there were two and even three of these walls, often connected by others to give them greater solidity. Outside of the wall was a ditch, always filled with water if circumstances permitted. The inhabitants were the defenders; and as their lives, liberty, and property were involved, the resistance in ancient sieges was more obstinate and persevering than that usually made in modern times. The modes of attack were by surprise, aided by treason or particular knowledge of unguarded points; by escalade, having surprised the place; by escalade in an assault, having outnumbered and overpowered the defenders; by blockade, having deprived

them of supplies; and by regular siege operations. When the siege seemed likely to last some time, the ancients were in the habit, if they expected sorties from the place or an attempt to relieve it from without, of securing their position by a double line of works, of circumvallation and countervallation. These were generally continuous lines constructed of earth, wood, and sometimes of masonry, flanked by towers. Annoying the besieged with missiles thrown from all the artillery known in that day, they pushed forward covered approaches on the points of attack. These were wooden frames, 7 ft. high, 8 ft. wide, and 16 ft. long, mounted on wheels, with a roof strong enough to resist the projectiles thrown by the besieged. They were covered with raw hides or turf, or protected by other expedients from being set on fire. The ditch when reached was filled with earth, logs, and stones, upon which the battering ram could be placed in position to breach the wall; or a descent was made into it for the purpose of undermining the wall. The battering ram was ordinarily placed in the lower story of a tower and suspended by chains or other mechanism. The tower was high enough to command those of the place, and was filled with armed men, who drove the defenders away from that part of the wall in its front. They were frequently aided by other towers pushed along on the ground or on inclined planes. The besieged, besides shooting lighted arrows and throwing incendiary compositions against the approaches, made sorties, which were usually bloody in their results, for want of covered ways or other exterior works beyond the ditch. The battering ram being in position, the besieged suspended beams of wood, stuffed contrivances like huge mattresses, and other devices, between the head of the ram and the wall, to deaden its blows. They sometimes used machines on the principle of the crane, by means of which they caught the head of the ram, or even the whole engine, and lifted it from the ground or overturned it. Archimedes devised such machines for the defence of Syracuse when it was besieged by the Romans, in 214–212 B. C. The wall being breached by the ram, or thrown down by undermining, preparations were made to assault the place through the opening. Often, while the besiegers were engaged in removing the ruins from the breaches, so that an assault could be made, the besieged were building a new wall in rear of the breach enclosing the part attacked, and the whole operation of moving forward the battering rams and breaching the wall had to be renewed. The surrender or capture was generally due to the exhausted condition of the besieged, rather than to the assaults. It was the custom for the besieging army to demand a surrender before they began the siege; and usually the besieged offered to capitulate before the final assault was made, as a hopeless resistance entailed death or slavery on all the defenders. Even in modern times the lives of the garrison are jeoparded if the besieged delay making terms until the final assault is successful.—*Transition Period.* The introduction of gunpowder in military operations led to the substitution of earthen trenches for the wooden covers and other ancient expedients, and also replaced the battering ram by heavy cannon. In this period, owing to the imperfection of the artillery, the want of connection between the approaches, and other deficiencies in the measures of attack, the besieged were often able to make a vigorous and prolonged defence, and sieges became the most important military operations of the time. Before 1741 there were more sieges than battles; from 1741 to 1783 the proportion was 67 sieges to 100 battles; during the French revolution the proportion was about 25 to 100; and during the first empire there were only 16 sieges to 100 battles. In recent wars these proportions have still further diminished. But the necessity for sieges still exists, and the rules and practice of taking a fortified place still hold a prominent position in the military art. The present method of attacking a fortified place by regular approaches is practically that organized by Vauban. Previous to his time, the middle of the 17th century, although many sieges had terminated successfully, there was no uniform system in the modes of attack. Vauban is especially credited with the invention of ricochet firing, the concentration of enfilading batteries, and the systematic arrangement of the parallels.—*Modern Sieges.* Let it be supposed that siege operations are to be conducted against a fortified place immediately upon the theatre of war. As the operations against a place fortified by any of the modern systems are governed by the same general conditions, and are practically the same until the besiegers reach the counterscarp of the ditch, the methods used will be fully explained by considering the mode of conducting an attack on a place fortified by the bastioned system. (See FORTIFICATION.) To simplify the explanation, it is supposed that the front to be attacked has the usual outworks and occupies a horizontal site, and that the cannon used by both the besiegers and besieged are the ordinary smooth-bore siege artillery. Irregularity of site and the use of heavier calibre or rifled cannon will only have the effect of increasing certain distances and adding to the difficulties of the siege, without affecting the principles common to them all. As the scarp walls are hidden from the besiegers' view by masks of earth, the object of the siege works is to reach, under cover, positions where openings in the walls can be made either by breaching batteries or mines; and under the shelter of these approaches troops can be brought up to make assaults through the openings. In this front, in order to make a breach in the scarp by artillery fire that will be practicable for the

assaulting column, the cannon must be placed on the crest of the covered way, and to make it accessible a descent into and passage of the ditch are necessary. If it is proposed to make an opening by mining, all the preliminary operations as far as the glacis of the work are identical. If the main work has outworks from which a reverse fire can be had on that part of the covered way where the breaching batteries are to be placed, they must first be taken. The accompanying plan will aid in explaining practical siege operations. The attack is made on bastion A, and as the adjacent demilunes D, D, those on the right and left of A, place the covered way of this point




1. Half of Plan of regular Approaches against a Front of Attack.

A. Point of attack. B. Adjacent bastion. D. Demilune of front of attack. C. Collateral demilune. E, F. Trench connecting first and second parallels. K, K. Demi-parallels. M, M, M. Enfilading, counter, and mortar batteries. T, T. Troops, called guards of the trenches, protecting the workmen on opening the first parallel.

2. Section showing Slopes and Dimensions of Profile of Approach by simple Trench.

A bastion corresponding to B, demilunes to C and D, and approaches on the left of A, are supposed to be indicated and to form the whole front of attack.

in a reëntrant angle, these demilunes must be taken before the bastion can be breached. This bastion and the adjacent demilunes with their outworks must be taken by breach or assault, and the fire from the collateral demilune C and bastion B shown in the plan, and the corresponding ones on the left not shown, must be kept under by opposing batteries during these operations, to enable the besiegers to carry on their work successfully. Approaches are made on the three salients, A, D, D, and these connected by parallels to hold large bodies of troops to protect the workmen and repel sorties. The siege operations may be divided into two general parts, one including all the measures taken to prevent ingress and egress, the other those required to gain possession of the place; but for convenience they are ordinarily classed into three parts, called the first, second, and third periods. The first period comprises the investment and the encampment of the besieging army around the place; the second, all the works from the opening of the trenches until the completion of the third parallel; and the third, all subsequent measures until the place is taken. The investment is performed by detaching a strong corps, who, moving quickly and secretly, suddenly surround the place, seize all avenues of approach, cut off all communications, and secure everything that may be of service to the defence. The main army follows and intrenches in positions around the place outside of cannon range. The intrenchments ordinarily form two lines, between which the besieging army places its camps, and are called lines of circumvallation and countervallation. They may be continuous or with intervals, the outer line being used to prevent succors, and the inner to resist the attacks of the garrison. This method of constructing lines and enclosing the army between them was used by the ancients, and fell into disuse during the middle ages. It was revived in the 16th century by the princes of Nassau, and has been practised more or less ever since. These lines not only enable the besieging army to repulse detachments that try to reënforce the place, but are also useful where the besieging army is forced to take up weak positions to complete the investment. The strength of the besieged work, the nature of the ground, and the facilities for transporting troops and supplies from the depots are governing considerations in selecting the front of attack. Salients are usually the weakest points of a fortification; low, marshy soil and rocky ground present the greatest difficulties in constructing siege works.—The second period begins with the opening of the trenches, which is done by digging a ditch or trench, between 600 and 700 yards from the most

advanced point of the fortification, from 3 to 4 ft. deep and 10 to 12 yards wide, and throwing up the earth in the form of a parapet on the side toward the work. This trench and all similar ones are constructed according to the general rules for throwing up field works; that is, they must afford a shelter from the enemy's fire, and permit those occupying them to use their arms with effect. The trench is extended far enough on each side of the point of attack to embrace all the positions required for batteries to keep down the fire of the collateral works. From its being parallel to or concentric with a line connecting the most salient points of the work, it is called the first parallel. At this distance, the fire of the besieged upon the workmen in the obscurity of twilight and darkness will not be troublesome; but the distance will be materially affected by irregularity of site and the size and kind of cannon used. At Sebastopol in 1854 the French established their first parallels, one at nearly 1,000 and the other at 1,800 yards, and the English at 1,800 yards, from the defences in their front. At Fort Wagner, Charleston harbor, in 1863, Gen. Gillmore opened his first parallel at 1,360 yards from the works. Accidents of the ground may enable the besieger to place it much closer. Communications are opened from the parallel to the depots in the rear, by trenches of the same general form, so arranged as to avoid an enfilading fire from the fortifications. As the besiegers desire to get as near as they can to the point of attack with as little sacrifice of life as possible, they make their advances by means of trenches similar in form to the parallel. These are pushed forward toward the point of attack, running in zigzag directions, crossing and recrossing the lines of the capitals of the salients, and avoiding enfilading fires from any point of the defences within cannon range. The approaches, called by many writers *boyaux* or branches, are as a general rule not longer than 100 yards, and, starting at the first parallel with a front of 60 yards, are narrowed to 30 yards at the third parallel. In this position along the capitals of the salients, they are less in the way and less exposed. These are shown in the plan, one to each salient, or three in this particular case, but there should be more if the circumstances require them. When advanced not quite half way between the first parallel and the fortification, they are connected by a second parallel, which in all essential particulars except in extent is like the first. Being constructed within destructive range of case shot, the flying sap is used instead of the simple trench, as more speedy cover for the workmen is obtained by it, and differs from it only in having the interior slope revetted with gabions. Being nearer to the first parallel than to the fortification, it is protected from sorties made against it in its unfinished condition, and its object is to protect the approaches as they are pushed forward from it. Vauban prescribes that there shall be at least three of these parallels. They serve as places of arms in which troops are stationed to protect the workmen and to resist sorties, as communications between the approaches, and to keep these free for the workmen and clear of troops. Only three, and the demi-parallels K, K, are shown in the plan, but there are often many more. At Sebastopol the French constructed seven, and at Fort Wagner Gen. Gillmore used five. Whatever the number, they should be placed in good tactical relations with each other, not so far in advance that the troops occupying the one in the rear cannot come to their support before they are reached by a sortie from the fortification. The besiegers place in front of the second parallel mortar, ricochet, and counter batteries, which, firing upon the work, break down the palisades, dismount the guns, and drive away the defenders. The use of rifled guns will cause these batteries to be placed further away from the work than is here represented, probably from 2,000 to 3,000 yards, in which case they should be enclosed in small works with a sufficient number of men in each to defend them. From the nearness to the work, the advance from the second parallel can only be made by means of saps. These are the flying, single or full, the double and half double saps, according to the direction and amount of fire to which the approach is exposed, and are constructed by engineer soldiers called sappers. When the foot of the glacis is reached, from 60 to 30 yards from the salient, the third parallel is constructed, demi-parallels which are long enough to contain troops to protect the workmen, and short enough not to hinder the fire from the batteries, having been made between it and the second parallel. The second period ends with the construction of the third parallel.—Thus far the advance and progress of the siege have been made without any great degree of difficulty or danger. This is now changed, and if the defence is vigorous future progress must be made under a murderous fire from the besieged, accompanied by many difficulties in the construction of the necessary works for protection. The advance on the nearest point of the covered way from the third parallel is by assault or by regular approach. The former is more rapid and more brilliant, but is seldom successful, and ought never to succeed if the besieged are not entirely exhausted and make even an ordinary resistance. It has been shown in recent wars that a single trench, defended by two ranks of infantry armed with the improved weapons of the present day, is almost unassailable by main force. In an attack by two divisions of infantry on a continuous trench before Petersburg, Va., defended by a single line of infantry, the number of the attacking force killed exceeded the total effective strength of the defenders. If it be decided to make the assault, the third parallel is arranged

with steps on the inner side to allow a detachment of picked men to sally out at a given signal with a front equal to that of the assaulting column. They are preceded by engineer officers, who mark out the lines for a trench four or five yards from the crest of the glacis, and extending around the salient place of arms, and are followed by a detachment of engineer troops to construct it. When everything is in readiness, all the batteries open fire on the place. At a given signal they cease, and the column of assault rushes forward and takes possession of the covered way. The engineers immediately make the sap, into which the troops retire if successful, and afterward connect it by suitable communications with the third parallel. The execution of this trench around the salient place of arms is called crowning the covered way. In 1708, at the siege of Lille, the covered ways of two of the salients of the front of attack were crowned by assault. The attack was made at nightfall by 10,450 men, not counting the troops in the trenches; they lost 2,000 killed and 4,000 wounded. The best engineering authorities are opposed to an assault except in case of urgent necessity, when a day gained may decide the fate of the besiegers themselves, or the time saved by it compensates for the immense loss of life that must accompany it. If the advance is to be made by regular approaches, they are started from the third parallel by saps, which when within 30 yards of the salient are spread out in a circular form to enclose it, and high mounds of earth, called trench cavaliers, are thrown up, by which a command over the covered way is obtained. Protected by them, the engineers advance their saps to the salients and extend them to the right and left along the faces, at least as far as the traverses, as in the case when the assault was made. As soon as this is done, they proceed to establish counter and breaching batteries to fire against the demilune and bastion. The former are placed around the salients so as to fire in the direction of the ditches against the portion of the work by which they are swept, while the latter are placed near the counter batteries and nearly opposite to the points where the breaches are to be made. Underground galleries are also constructed, by means of which a descent into the ditch can be effected. A breach is considered practicable for assault when the interior of the work is exposed for a width equal to the front of the column of attack and the débris forms a slope of easy ascent. If breaches are to be made at several points, the operations should be carried on and the assaults made simultaneously. The breach in the demilune will be carried by assault or by regular approach, and in all essential things there will be no difference in the mode of taking it from that described for the covered way. As soon as the breach is gained, it is crowned, or a lodgment made by encircling it with a trench in which troops are placed to prevent the besieged from regaining possession of the work. The demilune being taken, advances are made against the reëntrant places of arms and salient of the covered way of the bastion, if they have not already been crowned. Other batteries are established against the faces and flanks of the bastion, and operations similar to those already described are carried on against the main work. A capitulation will ordinarily follow the crowning of the breach in the bastion, unless there are interior retrenchments, in which case the same method of attack will be followed until there is no longer any defence between the besieger and besieged. The breaches are supposed to have been made by battering the ramparts with artillery fire. The other method is by means of mines, which are rarely used because of the slowness of the operation and the uncertainty of the result. The explosion of the mine gives no practicable slope for the use of the assaulting column, and this must be made by workmen before it can be used, which is very difficult and dangerous. To resist the approach of the besiegers, the defence make use of mines; to destroy these, and to advance their works, the besiegers also employ them. They will be most largely used between the third parallel and the main work. The passage of the ditch is a difficult and dangerous operation, rendered doubly so when the besieged have a wet ditch, or can make use of water in their defence. In an actual siege, a daily record is made by the engineers of the amount of work done and the time required, which is transmitted to headquarters and preserved. By comparisons of these records and the results obtained in engineering schools, the time necessary to complete all these works has been calculated. This time has been used in comparing the relative value of different systems or methods of fortification, by submitting them to a fictitious siege. It is of no value in practice, for the duration of sieges depends on laws which no method of calculation can determine. In order that the besiegers should be successful, their numbers and their armament should be in excess of those brought to resist them, and no fixed rules can be stated for this excess. As a general rule, supposing the investment to be complete, the besiegers should be about six times as numerous as the besieged, and should be kept so by sending the wounded and sick to the rear and replacing them by fresh troops. As the defence have not this resource, their numbers constantly dwindle until they are exhausted or overpowered.—Among the most celebrated sieges in history are those of Babylon, Tyre, Syracuse, Carthage, Numantia, and Jerusalem in ancient times, and of Constantinople, Antwerp, Bergen-op-Zoom, Stralsund, Candia, Lille, Buda, Schweidnitz, Saragossa, Sebastopol, Vicksburg, Strasburg, Metz, and Paris since the introduction of gunpowder.

**SIEGEN**, a town of Prussia, in the province of Westphalia, on the Sieg, 37 m. S. of Arns-

berg; pop. in 1871, 11,070. It is the chief seat of the tanning and leather industry of Westphalia, and has large manufactories of iron and steel ware, and of linen, cotton, and woollen goods. It is rapidly increasing in population. Rubens was born here.

**SIEGERT, Karl August,** a German painter, born in Neuwied in 1820. He studied at Düsseldorf under Hildebrandt from 1837 to 1841, and subsequently at the academy till 1846, travelled in various countries, and in 1851 became a professor of painting at Düsseldorf. He excels in genre pictures. His recent works include "Dinner Hour," "A Welcome Pause," "Sunday Morning," and "A Lay Brother distributing Alms."

**SIEMENS. I. Ernst Werner,** a German inventor, born at Lenthe, near Hanover, Dec. 13, 1816. He entered the Prussian army in 1834, became an artillery officer in 1838, busied himself with researches in electro-metallurgy, and took out in 1841 a patent for electro-plating and gilding. From 1844 he had charge of the government artillery works at Berlin, and also devoted himself to perfecting the electric telegraph. In 1848 he laid at Kiel the first submarine mines exploded by electricity. In 1849 he left the army and founded in Berlin the telegraph-building establishment of Siemens and Halske. Among the more important of Siemens's inventions are: the method of determining the position of injuries in subterranean and submarine lines; of examining insulated wires; of charging subterraneous and submarine conductors, in order to lessen the disturbing influences of induced currents in the cables. **II. Karl Wilhelm,** brother of the preceding, born at Lenthe, April 4, 1823. He studied at Göttingen, entered the Stolberg machine works, and in 1843 settled in London as a civil engineer. In 1858 he undertook the management of a London branch of the firm of Siemens and Halske of which he had become a partner. With his brother Werner he carried on investigations in electro-magnetism, and several important improvements in the manufacture of submarine cables and the mode of insulating with caoutchouc were made by them jointly. Assisted by his younger brother Friedrich (born Dec. 8, 1826), he instituted in 1846 experiments looking to the discovery of a more perfect combustion of fuel. The result was the regenerating gas furnace. (See Furnace, vol. vii., p. 543.) In perfecting this invention all the brothers took part, although the chief merit belongs to Wilhelm. In 1869 the Siemens steel works were erected at Landore in Wales, in which nearly 1,000 tons of cast steel are produced weekly, partly by the Siemens method directly from the ore, and partly from cast and wrought iron. Other inventions of Wilhelm Siemens are: the bathometer, a hydrostatic instrument for measuring depths at sea; the hydraulic brake to prevent the recoil of artillery on ships of war; a pyrometer (see Pyrometer), &c. He has published dissertations "On a Regenerative Condenser" (1850); "On the Conversion of Heat into Mechanical Effects" (1853); "On a Regenerative Steam Engine" (1856); and "On the Increase of Electrical Resistance in Conductors with Rise of Temperature, and its Application to the Measure of ordinary and Furnace Temperatures" (1871).

**SIENA, or Sienna. I.** A central province of Italy, in Tuscany, bordering on Florence, Arezzo, Perugia, Rome, Grosseto, and Pisa; area, 1,465 sq. m.; pop. in 1872, 206,446. It is watered by the Ombrone, Orcia, and other rivers. The N. E. portion is very mountainous. There are several lakes. A portion of the soil is fertile, producing wheat, olive oil, and wine; a larger portion comprises forests, prairies, and pasture grounds; much of it is uncultivated. Cattle raising is a chief occupation. It comprises the districts of Siena and Montepulciano. **II.** A city, capital of the province, on two hills in a dreary plain, 31 m. S. by E. of Florence; pop. in 1872, 22,965. The streets are narrow, and many of them too steep for vehicles. The cathedral, built in the 13th century, is a fine specimen of Italian Gothic, and there are several other churches which are rich in works of art. The university, which was flourishing in the middle ages, has a library of 50,000 volumes and 5,000 manuscripts. Siena is an archbishop's see, and has numerous academies of literature, science, and the fine arts. The hospital of Santa Maria della Scala is one of the oldest in Europe. The piazza del Campo, celebrated in Dante's *Purgatorio*, contains the loggia di San Paolo, the seat of a commercial tribunal in the middle ages.—Siena is a very ancient place, as the remains of Etruscan walls still visible testify. It was a bishop's see in the 6th century. In the middle ages it was a powerful republic, and rivalled Florence, with which it was often at war. In the struggle between the popes and emperors it sided with the Ghibelline party, and its soldiers defeated the Guelphs at Monte Aperto or Montaperti in 1260. The council of Pavia, transferred to Siena, lasted from June 22, 1423, to Feb. 26, 1424. A long period of civil war ended in its capture by the troops of Charles V. in 1555, and it was united with Tuscany in 1557.

**SIERRA,** a N. E. county of California, bounded E. by Nevada, and drained by the North and Middle forks of the Yuba river; area, 830 sq. m.; pop. in 1870, 5,619, of whom 810 were Chinese. It is situated among the Sierra Nevada mountains, and but little of it is less than 3,000 ft. above the sea. There are several isolated peaks, the most conspicuous of which are Table mountain, more than 6,500 ft. high; Saddle mountain, a little lower; and the Sierra buttes, 8,300 ft. high. Nearly the whole county is underlaid by auriferous slates, generally covered by volcanic accumulations. It is one of the chief gold-producing counties in the state. The surface is covered with a heavy growth

of coniferous trees. The land suited to agriculture or grazing is mostly confined to a few small valleys and mountain flats. The climate in winter is rigorous. The chief productions in 1870 were 7,794 bushels of wheat, 8,250 of oats, 10,415 of barley, 8,451 of potatoes, 39,200 lbs. of butter, and 7,466 tons of hay. There were 464 horses, 887 milch cows, 2,257 other cattle, 402 sheep, and 437 swine; 13 saw mills, 1 machine shop, and 6 quartz mills. Capital, Downieville.

**SIERRA LEONE,** a British colony on the W. coast of Africa, forming one of the West African settlements. It occupies a small peninsula terminating in Cape Sierra Leone, lat. 8° 30′ N., lon. 13° 18′ E., and extending N. to the estuary of the same name. Along the N. bank of this estuary is a narrow strip of territory belonging to the colony, which also includes the district around the mouth of the Sherbro river, about 70 m. down the coast; area, 468 sq. m.; pop. in 1872, 38,936, of whom 107 were Europeans and 1,741 were native Christians. The peninsula is mountainous, some of the peaks rising to the height of 3,000 ft. above the sea; but there are tracts of level ground, and several small valleys, the whole being well watered and for the most part densely wooded. The lower districts are purely alluvial, but in the more elevated parts the geological formation is volcanic, and iron ore occurs. Free Town is the capital, in addition to which the colony contains several considerable villages. The climate is deadly to Europeans. The wet season extends from May to November inclusive; the average annual rainfall is 160 inches, and the mean temperature not far from 82° F. From February to December, 1871, of the 98 Europeans resident at Free Town, 24 died, a death rate far exceeding any other in the British dominions. This excessive mortality, however, is confined to the coast; the mountain villages, only 3 or 4 m. inland from Free Town, are described as quite salubrious. The land breeze, which begins to blow in the evening, comes over swampy ground laden with malaria, and the unwholesome mists cling to the lower terraces. The soil is not naturally very productive, but cassada, cacao, maize, ginger, ground nuts, Guinea corn, yams, plantains, sugar cane, and fruits are all successfully grown. The principal exports are palm oil, nuts, hides, and timber; the total value of the exports in 1871 was £467,755, against imports to the amount of £305,849. In the same year 411 vessels of 110,646 tons were entered in the colony, and 409 of 110,919 tons were cleared. The established educational system is inefficient. The colony has two bishops of the church of England, and there are 100 Christian ministers of all denominations, many of the most intelligent being natives; but the Mohammedan priests from the interior have achieved tenfold the success of the Christian missionaries in making converts. The colonial governor, who is appointed by the crown and is officially known as the chief administrator, is the executive of all the West African settlements. He is assisted by a legislative council, of which some of the members are pure negroes. The revenue in 1871 was £80,486, collected partly by import duties on spirits, tobacco, and gunpowder, while the expenditure amounted to £76,130.—The settlement was originally formed in 1787 by Granville Sharp and other British philanthropists, with the view of providing a suitable home for destitute negroes from different parts of the world, as well as promoting African civilization. The first foreign inhabitants were destitute negroes from London, nearly 500 in number. These were followed in 1790 by more than 1,000 freed slaves who had been collected in Nova Scotia, in 1800 by about 500 maroons from Jamaica, and in 1819 by a disbanded West India negro regiment. In 1807 the Sierra Leone company, which was organized by Sharp, Wilberforce, and others, and had previously controlled the colony, transferred all its rights to the British government. From that time until recent years the population was largely augmented by the introduction of the negroes taken from slave ships by vessels of the British navy.

**SIERRA MADRE.** See MEXICO, vol. xi., p. 465.

**SIERRA MORENA.** See SPAIN.

**SIERRA NEVADA.** See CALIFORNIA, ROCKY MOUNTAINS, and SPAIN.

**SIEYÈS, Emmanuel Joseph,** count, better known as abbé, a French statesman, born in Fréjus, May 3, 1748, died in Paris, June 20, 1836. After completing his studies in the university of Paris, he took orders, received in 1775 a canonship in Brittany, and became in 1784 vicar general and chancellor of the bishop of Chartres. The ministry having invited French writers to present their views upon the summoning of the states general, he almost simultaneously published three pamphlets: *Vues sur les moyens d'exécution dont les représentants de la France pourront disposer en* 1789; *Essai sur les privilèges*, a vindication of the rights of the people; and *Qu'est ce que le tiers état?* The answer to this question, which he summed up in "the nation," made him famous as the oracle of the revolution. He was elected deputy to the states general, where he moved that the three orders should immediately meet in general assembly to verify their powers in common; and the privileged orders refusing to comply with this motion, he insisted that the third should declare itself the "national assembly." He drew up the oath taken by the deputies, June 20, 1789, and originated the organization of the national guards and the division of France into departments. In his *Aperçu d'une nouvelle organisation de la justice et de la police en France*, he proposed jury trial in civil as well as criminal cases. He was elected president of the assembly in 1790. After the flight of the king to Varennes, he vigorously opposed the establishment of a re-

public. In September, 1792, he took his seat in the convention, being elected by three departments at once. On the trial of the king, he at first protested against the unlawful assumption of powers by the convention; but yielding to the majority, he sat as one of the judges, and silently voted for death without appeal to the people. During the reign of terror he gave up his priesthood and pension, and skilfully avoided attention, but after the fall of Robespierre regained influence among the moderate party. He moved the restoration of the surviving Girondists to their seats in the assembly, and had a large share in the direction of foreign policy. On the establishment of the directorial government he was elected one of the five directors, but declined, contenting himself with being a member of the council of 500. An unsuccessful attempt was made to assassinate him in 1797. In 1798 he went as minister to Berlin, and secured the neutrality of Prussia. In May, 1799, he succeeded Rewbell as a member of the directory, of which he soon became president. After the *coup d'état* of the 18th Brumaire, of which he was one of the originators, the liberal constitution prepared by him was altered so as to suit the aspirations of the first consul; and while Bonaparte seized upon absolute power, Sieyès, after having been one of the provisional consuls, had to content himself with a seat in the senate, the presidency of which he held for a while. He also received as a compensation the princely estate of Crosne, with a large income. Although he figured among those opponents whom Bonaparte styled ideologists, he was afterward made a count. In 1814, while absent from the senate, he, through Talleyrand's advice, adhered by letter to such measures as were taken by that body against the emperor, but was nevertheless made a peer during the hundred days. He however stood aloof, censured the "Additional Act to the Constitution of the Empire," and appeared neither at the meeting in the Champ de Mai nor at the opening of the chambers. On the second return of the Bourbons, he sought a refuge at Brussels. After the revolution of July, 1830, he returned to Paris. One volume of his collected works, edited by Cramer, appeared in 1796.—See *Étude sur Sieyès*, by E. de Beauverger (Paris, 1851).

**SIGISMUND**, emperor of Germany, the last of the Luxemburg line, born in 1368, died Dec. 9, 1437. He was the second son of the emperor Charles IV., and became elector of Brandenburg, while his elder brother Wenceslas succeeded to the empire in 1378. He was affianced to Mary, daughter of Louis the Great of Hungary and Poland, and was designated as successor in both kingdoms. But on the death of Louis, in 1382, the Poles rejected him, while an adverse party in Hungary raised Charles the Little of Naples to the throne. Charles was assassinated, and Sigismund, having espoused Mary, was crowned king of Hungary (1387). He fought the Turks, was routed by Bajazet at Nicopolis in 1396, and fled to Greece; and when after several years he returned to Hungary, he had to contend against a new rival, Ladislas of Naples, who finally withdrew in 1403. In 1400 the incapable emperor Wenceslas had been deposed and succeeded by Rupert of the Palatinate, and on the death of the latter in 1410 Sigismund and his cousin Jodocus of Moravia contested the imperial crown. The electors were at first divided, but on the death of Jodocus in 1411 Sigismund was elected. He called a general council at Constance, violated the safe-conduct accorded to Huss, and provoked the great Hussite war. He succeeded Wenceslas in Bohemia, received the Lombard crown in 1431, and was crowned at Rome in 1433. He was succeeded by his son-in-law, Albert II. of Hapsburg.

**SIGISMUND I., II., and III.**, kings of Poland. See Poland, vol. xiii., pp. 645–'6.

**SIGMARINGEN.** See Hohenzollern.

**SIGNAL SERVICE.** Organized signal services existed in armies from very early periods. Polybius (about 200 B. C.) mentions the wonderful skill acquired by the signal corps of his day. In later years semaphores were used with armies, and codes of flag signals became common for fleets. The invention of the electric telegraph greatly developed organizations of this description. Telegraphic corps are now attached to many armies, and field signals are widely used. Messages of any description, and in words or characters of any language, can be sent by signals, by day or night, as far as one man can by telescopes or other means be made visible to another. The apparatus can easily be carried in the hand on horseback or on foot. To transmit any message by the use of portable signal apparatus, a distance of 10 m. would be now considered easy. Ranges of from 16 to 20 m. are often reached in ordinarily clear weather; and on the western prairies messages have been transmitted 30 m. by flags. In time of war systems of reports are sometimes organized to cover extensive sections of territory. In some instances communication can be had from stations on elevated points over the heads of an enemy.—The signal service of the United States army is equipped to maintain communication by signals, by telegraph, or by semaphores, between officers or the different portions of an army or armies, or between armies and fleets. In time of peace it transmits intelligence in reference to storms or approaching weather changes by the display of signals of warning, and by reports at the different cities and ports of the United States. Maps showing the weather conditions are exhibited at board of trade rooms, chambers of commerce, and other places of resort. Bulletins of data are also prominently displayed, and are furnished without expense to leading newspapers. Signal stations are established also in connection with

life-saving stations, which are connected by telegraph, and, in addition to displaying storm signals and making the regular meteorological reports, are required to make special reports upon tempests at sea, the sea swell, currents, temperatures, &c. They also summon assistance to vessels in distress, either from neighboring life-saving stations or from the nearest port. Stations for river reports, to give notice of dangerous floods or conditions of the rivers affecting navigation, are established upon the courses of the great interior rivers. The officers and men of the signal service are instructed for the different branches of the service at the signal school of instruction at Fort Whipple, Va., and at the central office in Washington. They are taught the use of meteorological instruments, the modes of observing, and the forms and duties required at stations of observation, and for the display of storm signals. The force is also drilled with arms and in the usual duties of soldiers. The field telegraph trains of the signal service are organized for use with armies, and are managed by soldiers who are drilled to march with, manœuvre, work, and protect them. The trains carry light or field telegraph lines, which can be very quickly erected or run out at the rate of two or three miles an hour. They can be put in use for any distance, and as rapidly taken down, repacked, and marched off with the detachment to be used elsewhere.—For the duties of the observation of storms, and for the display of storm signals, all stations communicate directly with the signal office in Washington over telegraphic circuits arranged with the different telegraph companies, or connecting with the office at fixed hours each day and night. Each station is supplied with the following instruments: barometer, thermometer, maximum thermometer, minimum thermometer, Robinson's anemometer with electrical attachment and self-registering apparatus, hygrometer, wind vane, rain gauge, and, on stations located on rivers, lakes, or seacoast, thermometers designed for taking the temperature of water at different depths. The readings of these instruments, made three times a day at fixed hours, are reported to the central office in cipher. The stations at which cautionary signals are displayed are equipped with flags and apparatus for exhibiting the cautionary day or night signal. These stations are established (with the exception of those in the principal cities) solely with reference to the importance of their position for meteoric observations. Three graphic charts are prepared at the central office on the receipt of each report, as follows: 1. A chart of barometric pressures, temperatures, and winds, together with the wind velocities at the different stations, and the precipitation occurring; it exhibits the barometric pressures and the temperatures in their relation to districts and to each other by a system of isobaric and isothermal lines, and the wind directions by arrows at the different stations. 2. A chart of the cloud conditions prevailing over the United States, on which the different varieties and amount of clouds visible at the different stations appear by symbols; on this chart is also indicated the weather as reported at each station, the direction and movement of upper and lower clouds, and each morning the minimum temperature of the preceding night, in relation to districts of territory. 3. A chart showing the relative humidities over territorial districts, with the temperature at the several stations; this enables studies to be made for territorial sections, the difficulties attending the study of observations of this character being obviated to a very considerable degree by the intercorrections of the stations among themselves, and by the great extent of the regions over which the readings are simultaneously made. In the study of the charts for the reports, the well known rules and generalizations established by the experience of meteorologists are used. The published office report, based upon each general report of observations, consists of a synopsis of the meteoric conditions existing over the territory of the United States at the time of the report, and a statement of the changes likely to occur within the next 24 hours. For the purposes of convenient study and of condensed description, the territory of the United States is arbitrarily divided into districts. The reports from the stations, extending over territory reaching from the Atlantic to the Pacific, and from the capes of Florida into British America, are not unfrequently concentrated at the central office in the space of 45 minutes. In military lines connecting frontier posts and lines connecting life-saving stations upon the seacoast, the telegraphic duties are performed by the men of the signal service. The reports are those of readings of the different meteorological instruments made as nearly simultaneously as possible. The reports, made simultaneously from all the stations and received at the central office thrice daily, at intervals of about eight hours, are at once entered graphically upon synoptic charts (the weather maps), and from the study of these charts a deduction is had as to probable weather changes within the ensuing 24 hours. This deduction is furnished to the press and is telegraphed to 21 centres of distribution, to be there published and distributed in bulletin form for the use of farmers. The bulletins are displayed at post offices in numerous villages in the agricultural districts. In the case of serious storms noticed as approaching the lakes, or threatening any part of the seacoast, cautionary signals are ordered from the central office to be displayed at the different lake and sea ports and upon the coasts, as a warning to mariners. The fortunate position of the territory of the United States and its great extent enable a service of this kind to be conducted with especial advantage. The movements of the storms over the continent can be

traced upon the charts from report to report, and the direction and rate of their progress together with their intensity be noted in time to give warning of their approach. Floods occurring upon the western rivers can be traced sometimes from the fall of rain within the respective watersheds, and along the courses of the different confluent streams, until culminating in the dangerous flood of the principal river. In nearly the same manner that storms can be traced upon the charts, approaching changes of temperature and rainfall are foreseen, and notice is frequently given in time to prevent injury to agricultural and other interests. In the analyses of the official deductions of the office, or the "probabilities," the percentage of verifications is found to have been as follows: 1872, 76·8 per cent.; 1873, 77·6 per cent.; 1874, 84·4 per cent. The cautionary signal is a red flag with a black centre by day, and a red light by night. This signal indicates a probability of stormy or dangerous weather for the port or place at which it is displayed, or in that vicinity. While storms of limited extent, such as squalls, tornadoes, &c., may spring up suddenly or pass between stations in such a way that their coming or courses cannot be foreseen, extensive and well defined disturbances can as a rule be readily traced in time to forewarn the coasts or districts threatened. Arrangements have been made with the chiefs of meteorological services in Europe, in accordance with the recommendation of the Vienna conference of meteorologists (1873), providing for the exchange daily of one report taken at the same instant over all the territories of the United States, nearly all Europe, extending through Russian Asia to the Pacific coast, and in the northern portion of Africa. These exchanges are made every 15 days by mail. Besides the daily bulletins and weather maps, the signal office publishes a weekly review of the weather which is furnished to the press, and a monthly review, accompanied with charts showing the isobaric and isothermal lines, the prevailing winds, the tracks of low barometer, and a precipitation chart for the month.

**SIGNALS, Fog.** See Lighthouse, vol. x., p. 457.

**SIGNALS, Naval.** Naval signals are frequently mentioned by the classical writers, and recent investigation has discovered the fact that the system which prevailed during the naval supremacy of Greece and Carthage bore a striking resemblance to our present army code, invented by Gen. A. J. Myer, U. S. A. Signal flags began to be used in the English navy in the time of Elizabeth, or perhaps a little earlier. In the reign of James II. their use was somewhat systematized, and in 1790 or thereabouts, under Earl Howe and Kempenfelt, a regular code of day and night signals was perfected. Besides flags during the last century, arbitrary signs were used as signals, which were well known to all seafaring people. The signal to unmoor ship, for example, was the loosing of the maintopsail; that to prepare for sailing was loosing the foretopsail and firing one gun. In general there are three classes of signals: those for the day, made by square flags and triangular pennants variously colored of red, blue, white, and yellow; night signals, made with colored lights, rockets, &c.; and fog signals made by steam whistles, fog horns, bells, or guns. By means of the "International Code of Signals for the use of all Nations," all maritime countries use the same kind of signal flags, and having the signal book of each country printed in its own language, ships of different nationalities communicate as readily with each other as ships sailing under the same flag. In most systems the signal flags represent the numerals from 1 to 10, and in the signal book, corresponding to the numbers from 1 up to several thousand, are words and phrases most likely to be used by ships. But in the code just referred to the consonants of the alphabet were used in preference to numerals, by which means it was found that with 18 flags more than 78,000 distinct signals could be made without displaying more than four flags at a time. The number of flags and their position are also significant. Thus, when but two flags are shown, "danger" or "urgency" is implied. If in a signal consisting of two flags a burgee (a swallow-tail flag) is uppermost, it is known at once to be an "attention" signal. If a pennant is uppermost, it is a compass signal. A square flag above indicates an "urgent" signal. Three flags in one hoist express "latitude, longitude, time," and all ordinary signals required for communications. Four flags indicate geographical signals. The flags representing the alphabet are for spelling out words not found in the vocabulary. With a pennant above, the name of a ship of war is indicated; with a square flag uppermost, that of a merchant vessel. Observing, then, the colors of each flag, we seek in the signal book the same combination of letters and the corresponding message. Let us suppose, for example, that on the meeting of two ships at sea one is observed to hoist two flags. We know at once it is an urgent signal, and on closer examination find the upper one divided vertically, in white and red, the lower one a red burgee. The upper flag represents the letter H, the lower one the letter B. The combination H B in the signal book stands opposite the sentence, "Want immediate assistance." Thereupon the second ship hoists a white and red vertical flag (H), and beneath a red pennant with white ball in centre (F). H F in the signal book corresponds to the sentence, "We are coming to your assistance." As each ship has a signal book printed in the language of its country, this code furnishes a kind of universal language. If the ship first mentioned had found herself on a strange coast, she might have made the same signal to a shore station, and received

the friendly aid of a life boat. Should the distance between two points be too great to distinguish colors, the shape alone indicates the value of the signal, for which purpose a ball, a long pennant, and a square flag are used, known as "distance signals." In addition to the above, each national marine has a system of signals adapted to its own particular wants, not only for holding free communication among the ships of a fleet, the transmitting of orders, conveying of intelligence, &c., but to enable the commander-in-chief of a naval force to signal orders to his ships for the various evolutions of naval tactics. A complete naval signal book comprehends therefore a system of evolutionary tactics. For night signals, red, green, and white lights are used to represent those colors in the flags of the day signals, the green light taking the place of the blue bunting. The night signals known as the "Coston lights" are the best in use.—The greatest improvement of recent times in signalling is that made by Gen. A. J. Myer, already referred to. For its perfect simplicity and comprehensiveness it is now considered indispensable to both branches of the public service. The letters of the alphabet are represented by combinations of the numerals 1 and 2 for spelling the words of a message. Each word is punctuated by a comma represented by the numeral 3; 1, 2, and 3 being represented by arbitrary signs. A, for instance, is represented by 2-2, B by 2-1-1-2, C by 1-2-1, &c.; 3 indicates the end of a word, 3-3 the end of a sentence, and 3-3-3 the end of the message. There are also abbreviations. The signals commonly used to represent these numbers are as follows: The signalman, facing his correspondent, waves a flag (at night a lighted torch) to his right to indicate 1, bringing his flag to a rest in a vertical position; to the left to denote 2; and to his front for 3. By waving his flag or torch to his right and left he spells out the words of his message, using frequent abbreviations, so that two expert signalmen may transmit long communications with great rapidity and exactness.

**SIGOURNEY, Lydia Huntley**, an American authoress, born in Norwich, Conn., Sept. 1, 1791, died in Hartford, June 10, 1865. In 1814 she opened a private school in Hartford, and in 1815 published "Moral Pieces in Prose and Verse." In 1819 she married Charles Sigourney, a merchant of Hartford. In 1840 she visited Europe, and recorded her reminiscences in "Pleasant Memories of Pleasant Lands" (1842). She published nearly 60 volumes of poems, prose, and selections. Among her works are: "Letters to Young Ladies" (1833); "Pocahontas, and other Poems" (1841); "Past Meridian" (1854); "The Man of Uz, and other Poems" (1862); and her autobiography, posthumously published under the title "Letters of Life" (New York, 1866).

**SIGÜENZA Y GONGORA, Carlos de**, a Mexican scholar, born in Mexico in 1645, died there, Aug. 22, 1700. He was chaplain to the archbishop of Mexico, and taught astronomy and mathematics in the university of that city for 20 years. King Charles II. of Spain created him royal cosmographer and mathematician. He had several discussions on the nature of comets with Father Kuhn, the colonizer of California, and wrote histories of Texas and the Chichimecas, an account of the recovery of New Mexico after the revolt of 1680, and a history of the university of Mexico. With Juan de Alva Ixtlixochitl he prepared several treatises on Mexican antiquities and early American history, which perished with his library in the great fire of June, 1692. He was director of the military school of Mexico for several years, and in 1693 was appointed to accompany the expedition of Andrés de Pés against the French settlements in the gulf of Mexico. He planned the fortifications of Pensacola, and soon afterward published maps of the bays of Pensacola (Santa Maria de Galve) and Mobile, and of the Rio de la Palizada or Mississippi. His name was subsequently given to one extremity of Santa Rosa island and to the fort erected there. He entered the society of Jesus in 1693. His principal works are: *Ver Indicum, Poema sacro-epicum* (8vo, Mexico, 1668; 4to, 1680); *Expositio Philosophica adversus Cometas* (1681); *Triumphus Parthenicus* (4to, 1684); *Libra Astronomica et Philosophica* (1690); *Infortunia Alfonsi Ramirez circum per Orbem euntis* (1693); *Mercurius volans et Novum Mexicum restauratum præ se ferens* (1693); *Descriptio Sinus Sanctæ Mariæ de Galve* (1693); and a topography of Mexico and its neighborhood, enlarged and republished by Alzate in 1786.

**SIHON**, a name applied by some geographers to the Sir Darya or Jaxartes. (See JAXARTES.)

**SIKHS** (Hind. *sikh*, a disciple), a people of India, chiefly inhabiting the Punjaub. They were originally a religious sect, the founder of which was Nanak, a Hindoo of the warrior caste, born in 1469 near Lahore, who was a deist, advocating the worship of God without regard to form as an essential, universal toleration, and a fusion of Brahmanism and Mohammedanism, on the basis of a pure monotheism and of human brotherhood. He died in 1539, and was succeeded by his son Angad, who wrote commentaries upon his father's system, which underwent considerable change at the hands of his successors Amardas and Ramdas. Arjoon, the son of Ramdas, compiled the Sikh doctrines in a volume called *Adi-Granth*, established himself at Amritsir in 1581, and organized his followers, who had hitherto been only a religious community, into a confederation possessing also a political character, of which he became the sole chief. As the Sikhs rejected alike the Koran and the Vedas, they drew down upon themselves the hatred both of Moslems and Brahmans; and notwithstanding the peaceable increase of the sect up to that period, Arjoon was imprisoned by the

Mussulman government, tortured, and put to death in 1606. His son, Har Govind, to avenge his death, led the Sikhs against their Mohammedan foes; but they were driven from the region which they occupied about Lahore, and forced to find refuge in the mountains in the north. In 1675 Guru Govind, a grandson of Har Govind, became their tenth theocratic chief, gave them a code of laws, and organized them as a state. He added to their sacred books by writing the biographies of his nine predecessors. He abolished caste, established absolute equality, and introduced a peculiar dress, such as the wearing of blue, peculiar customs, such as allowing the hair and beard to grow long and uncut, and peculiar requirements, such as that every man should be a soldier and always carry steel. He recommenced the struggle against the Mogul emperors, but without avail, and was defeated and finally murdered by a private enemy. His successor, a chief named Banda, renewed the contest early in the 18th century, devastating the eastern Punjaub and Sirhind with such success that Bahadoor Shah himself took the field against the Sikhs, and partially repressed their rising power. In 1716 they were overwhelmingly defeated and almost annihilated. Their religious fervor decreased, and for many years they did not recover from this blow; but they finally united their roving bands and drove the Afghans from the Punjaub in 1764. For the following 30 years they were divided into 12 small confederations, called *misals*, which were governed by *sirdars* or petty chiefs, of whom Maha Singh was the most powerful. After his death in 1794, his son Runjeet Singh brought the other sirdars into subjection, and reduced the Punjaub to his sway. (See Runjeet Singh.) When this distinguished Sikh chieftan died, in 1839, his dominions, known as the kingdom of Lahore, included all the principal Sikh states except those E. of the Sutlej. They soon fell into anarchy, the power of the army became supreme, and war with the English broke out in 1845. Battles were fought and victories won by the British, under Sir Hugh Gough, at Moodkee, Dec. 18; at Ferozeshah, Dec. 21 and 22; at Aliwal, Jan. 28, 1846; and finally at Sobraon, Feb. 10, where the Sikhs lost 10,000 men. The contest then terminated in a treaty by which the greater part of their territory and almost their entire government was ceded to the East India company. This treaty soon led to new complications, and to a second war between the British and the Sikhs, beginning in 1848. Mooltan was invested in the autumn of that year, and taken in January, 1849; but the British, under Gough, were repulsed and narrowly escaped disastrous defeat at the battle of Chillianwallah, Jan. 13, when they lost 2,446 killed and wounded. A subsequent victory at Guzerat, in February, concluded the war; the Sikh army surrendered, and the Punjaub was incorporated into the British dominions. The only portion of the Sikh territories remaining independent is comprised in the nine small states of Sirhind. The Sikhs were faithful troops during the sepoy mutiny of 1857, and aided materially in its suppression.—In 1868 the number of Sikhs in British India was officially stated at 1,129,319. Their ethnological affinities are with the Jats. In spite of the destruction of their commonwealth, they maintain their national characteristics, being tall, thin, dark, and active, excellent soldiers and horsemen, frank, sociable, and pleasure-loving. Amritsir is their spiritual capital.

**SIKKIM,** a native state of British India, on the S. slope of the Himalaya range, bounded N. by Thibet, E. by Bhotan, S. by Bengal, and W. by Nepaul, between lat. 27° and 28° 10′ N., and lon. 88° and 89° E.; area, 2,544 sq. m.; pop. about 7,000, principally mountaineers. The surface consists of a series of ranges of the Himalaya mountains, which on the south rise abruptly from the plains to the height of from 6,000 to 10,000 ft., and increase toward the north and northwest, where Kintchinjunga, long believed to be the loftiest point on the surface of the globe, attains a height of more than 28,000 ft. above the sea. The mountains are separated by precipitous ravines, nowhere wide enough to form plains. The drainage belongs to the basin of the Ganges, toward which it flows by the Teesta, which rises in Thibet, and pursues a winding course through Sikkim. The mountains are covered with vegetation to the height of 12,000 ft., and at the lower levels it is often very luxuriant. Sikkim abounds in fine timber, producing oak, walnut, chestnut, and cherry at elevations of from 6,000 to 8,000 ft., and saul and sissoo further down. Copper is the chief mineral product. The soil consists mostly of a rich black mould; and the principal crops are millet, maize, and rice, the last of which has been cultivated to the height of 8,000 ft. above the sea. The aboriginal inhabitants have Mongolian features, and speak a Thibetan dialect.—The Gorkhas conquered Sikkim in 1789, and it became tributary to them; but during the Nepaul war of 1814 the rajah coöperated with the British, and in 1817, after peace was concluded, his independence was guaranteed, and his dominions were increased by the grant of certain tracts of Nepaulese territory. In 1836 the rajah ceded Darjeeling to the British, for an annual grant of £300, subsequently increased to £600. In 1849 he countenanced some outrages on British subjects, which led to a temporary forfeiture of this allowance, and a further loss of territory. In 1861 he opened his dominions to British trade without restriction, and in 1872 his allowance was increased to £1,200. His capital is Tumloong.

**SILENUS,** in Greek and Roman mythology, a satyr prominent in the retinue of Bacchus. He is differently called the son of Mercury and of Pan, and is represented as a jovial old man with a bald head, a pair of goat's ears,

and a fat, sensual face, always intoxicated, and either mounted upon an ass or carried by satyrs. In the contest with the giants Bacchus was assisted by Silenus, who slew Enceladus. Silenus is also represented as an inspired prophet, and a sage who despised the gifts of fortune. When he was drunk and asleep, any one could compel him to prophesy by surrounding him with a garland or chain of flowers. There was a temple sacred to him at Elis. Several poems and works of plastic art introduced more than one Silenus at a time, representing the older satyrs.

**SILESIA** (Ger. *Schlesien*), **Austrian**, a duchy comprising that part of Silesia which remained to the house of Austria after the peace of 1763, bounded by Prussian Silesia, Galicia, Hungary, and Moravia; area, 1,988 sq. m.; pop. in 1874, 544,459, of whom about 14 per cent. were Protestants, 1 per cent. Jews, and the remainder Roman Catholics. Fully one half of the population are Germans, 29 per cent. Poles, and over 19 per cent. Czechs. The Carpathian mountains pass through it in the southeast, and the Moravian in the northwest, and it is watered by the upper Oder, the Vistula, which rises in the province, and other rivers. About one third of the territory is covered with forests. It is one of the most important grazing provinces of Austria. The mining and weaving industries are important. Before 1849 it formed with Moravia a single administrative province, and then became a separate crown land under the name of the duchy of Upper and Lower Silesia. Until 1866 it was one of the 11 Austrian states belonging to the German confederation, and since 1867 it has been one of the 14 Cisleithan provinces represented in the Reichsrath. The principal towns are Troppau, the capital, Teschen, Bielitz, and Jägerndorf.

**SILESIA, Prussian**, the S. E. province of Prussia, bounded N. by Brandenburg and Posen, E. by Russian Poland and Austrian Galicia, S. by Austrian Silesia and Moravia, and S. W. and W. by Bohemia, the kingdom of Saxony, and the Prussian province of Saxony; area, 15,556 sq. m.; pop. in 1871, 3,707,167, of whom 1,760,341 belonged to the Evangelical church, 1,896,136 were Roman Catholics, and 46,629 Jews. It is divided into the districts of Breslau, Liegnitz, and Oppeln. It is separated from the Austrian dominions by the Sudetic chain of mountains, which consist of long well wooded ridges with isolated peaks. There are two principal groups, the Riesengebirge in the N. W. part of the range and the Glatz mountains in the opposite direction; the most elevated peak of the former, the Schneekoppe, is upward of 5,000 ft. high, and of the latter, the Great Schneeberg, nearly 5,000 ft. There are fertile valleys of considerable extent. The Oder flows through the province in a general N. W. direction, and divides it into two nearly equal portions, that on the left of the river being mountainous, and that on the right flat. This level portion is sandy, with extensive tracts of heath and stagnant pools. A small portion of the S. E. corner is drained by the upper course of the Vistula. The mineral wealth of Silesia is confined principally to the upper or S. E. part of the province. Gold and silver are procured in small quantities; copper, lead, and zinc are found; and coal and iron are abundant. Quarries of limestone, marble, and sandstone are worked. Large numbers of cattle and sheep are raised, the wool of Silesia being of superior quality, and forming next to linen the chief export. The principal manufactures are of linen, cotton, and woollens, iron, paper, leather, glass, porcelain, castings, and sheet iron. Among the principal towns, besides Breslau, the capital, are Glogau, Liegnitz, Oppeln, and the fortresses Schweidnitz, Neisse, Glatz, and Kosel.—Silesia became subject to Poland in the 10th century, and in 1163 it was ruled by three independent Polish princes. It was afterward subdivided into numerous petty states, which in detail became tributary to the king of Bohemia, and fell to Austria in 1526. The claims of Frederick the Great upon the former duchies of Liegnitz, Brieg, Wohlau, and Jägerndorf, founded on an old treaty of inheritance, gave rise to three wars for the possession of Silesia, the first in the years 1740–'42, the second in 1744–'5, and the last in 1756–'63 (the seven years' war). By the treaty of Hubertsburg in 1763 the province was finally secured to Prussia, except the part now known as Austrian Silesia. A part of Lusatia was added to it by the treaties of 1815.

**SILICA.** See SILICON.

**SILICATES, Soluble.** See GLASS, SOLUBLE.

**SILICON**, or **Silicium**, the essential constituent of silex or flint. It is obtained in a dull brown amorphous powder by passing the vapor of chloride of silicon over heated potassium or sodium contained in a glass tube. It may also be obtained from the aqueous solution of the gaseous fluoride of silicon. Neutralized with solution of potash, this affords a silico-fluoride of potassium, which when well dried is mixed in a glass or iron tube with $\frac{8}{10}$ or $\frac{9}{10}$ of its weight of potassium or sodium and heated. The silicon set free partially combines with the excess of the alkali, from which it is finally removed by washing in water. When heated in air or oxygen, it burns vividly, and with such intense heat as to fuse the external crust of silica. In its chemical properties silicon exhibits striking analogies with carbon and boron. When strongly heated in a close platinum crucible, it becomes darker and of greater specific gravity; it loses its affinity for oxygen, so that it will not ignite even if heated by the blowpipe and immersed in oxygen, and is not attacked by pure hydrofluoric acid. If aluminum be substituted for the sodium of the above experiment, silicon is obtained in a crystalline condition. Two methods are employed to prepare crystalline silicon: 1,

fuse a mixture of 5 parts pulverized glass, 10 parts cryolite, 1 part aluminum, and wash the product with hydrochloric and hydrofluoric acids; 2, fuse 15 parts silico-fluoride of sodium, 20 parts granulated zinc, 4 parts sodium, and wash with hydrochloric and nitric acids. Amorphous silicon was discovered by Berzelius in 1824, crystalline by Deville in 1855. Crystalline silicon forms brilliant black scales having a lustre like that of specular iron ore, sometimes prismatic, at others octahedral, foliated, graphitic, with a specific gravity of 2·49. The symbol of silicon is Si; atomic weight, 28. It is a poor conductor of electricity, fuses at a temperature between that of cast iron and steel, is harder than glass, and is insoluble in all acids excepting hydrofluoric and nitric. There were at one time supposed to be three modifications of silicon, the amorphous, graphitoid, and crystalline, but the graphitoid is now regarded as somewhat problematical. Silicon belongs to the class of tetrads, being equivalent in its most usual combinations to four atoms of hydrogen.—There is but one anhydrous oxide of silicon, commonly known as silicic acid or silica; its formula is $SiO_2$. Silica, or silicic anhydride, occurs in nature dimorphous: 1, in hexagonal prisms with terminated pyramids, as quartz, rock crystal, smoky quartz, amethyst, &c.; 2, in wedge-shaped crystals, with sharp angles, or hexagonal tables, or in twins (called tridymite), colorless and clear as water. The former has the specific gravity of 2·6, the latter of 2·3. Its only solvent among the acids is the hydrofluoric, by means of which it is decomposed, and a gaseous compound is obtained of its base with the acid. When passed into water this combination is broken up, and silica is reproduced in the form of little bubbles and white flocculi, which by washing and igniting become perfectly pure and snow-white silica. Pulverized silica, when mixed with an alkaline carbonate and fused, dispels the weaker carbonic acid, and itself combines with the alkali, thus exhibiting its properties as an acid. But these are too feeble to act upon test paper. An excess of silica in the alkaline mixture determines the production of glass, which is insoluble in water or common acids; but if no more silica be added to the melted mass after this ceases to effervesce on its introduction, the product after being cooled may be dissolved in water. When silica is separated from its alkaline combination by hydrochloric acid, it appears before evaporation as a jelly, which is a hydrate of silica, soluble in a large excess of water; but once deprived of water by heat, it can no more be dissolved. Silica of this character is met with in several mineral compounds. It constitutes the opal, in which the proportion of water varies from 3 to 10 per cent., and also great deposits of a white silicious earth made up of infusorial remains. The zeolites are hydrated silicious compounds, which when finely pulverized and treated with hydrochloric acid swell up into the transparent jelly.—Silica is an important element in the composition of the grasses, and forms in chief part the hard external coat of the reeds. It combines with bases and forms silicates, among which are found a large proportion of the minerals. Their variety is multiplied by the number of bases, as lime, alumina, magnesia, protoxide of iron, and several of the other metals, and by the diversity in the relative proportions of the different silicates, the substitution of one base for another. They comprise the hydrous and anhydrous silicates, the former including, besides those already named, the talcs, serpentines, and chlorites, and the latter the augites, garnets, micas, and feldspars. They are for the most part fusible, and those melt easily which consist largely of fusible oxides. They are decomposed by vegetable acids, and gradually even by the carbonic acid gas of the atmosphere; but at high temperatures in a furnace the silica, not being volatile, takes the place of most other acids, expelling even sulphuric acid from its combinations.—Diatomaceous or infusorial silica, of which large deposits have been found in Nevada, New Jersey, and Virginia, is now employed in the arts for a great variety of purposes, among which are: as a polish for metals under the name of tripoli or electric silicon; as a non-conductor in refrigerators and fire-proof safes; as an absorbent of nitro-glycerine in the manufacture of dynamite; in the manufacture of glass, enamel, pottery, and soluble glass. Chloride of silicon, $SiCl_4$, is a transparent, colorless liquid, with a pungent, acid, irritating odor. It is very volatile and fumes strongly in the air, and is prepared by the action of chlorine on a heated mixture of silica and charcoal. Fluoride of silicon, $SiF_4$, is a colorless gas of a peculiar, pungent acid odor, which is evolved when equal parts of finely powdered fluor spar and silicious sand or powdered glass are mixed, in a capacious flask or retort, with 12 times their weight of oil of vitriol. The gas was converted into a liquid by Faraday. When a stream of gaseous fluoride of silicon is transmitted through water, it is partially decomposed and partially dissolved. Two atoms of water react on three of fluoride, and produce silico-fluoric or hydrofluosilicic acid, which is dissolved, while one third of its silicon is deposited as silica. Efforts have been made in metallurgical operations to economize the fluoride of silicon and hydrofluosilicic acid hitherto wasted, and to employ the latter in the beet-sugar refinery and for chemical uses.

**SILISTRIA** (Turk. *Dristra*), a fortified town of European Turkey, in Bulgaria, on the right bank of the Danube, 57 m. N. N. E. of Shumla and 230 m. N. N. W. of Constantinople; pop. with the garrison about 20,000. The river is here more than 1,200 ft. wide, and studded with numerous islands between the town and the Wallachian shore. There are several mosques, a large Greek church and convent, capacious

barracks, public baths, and a custom house with magazines for storing grain and flour. It has no important manufactures, and the chief trade is in wood and cattle. It is a very ancient place, and near the city are remains of fortifications erected during the Byzantine empire. In 971 the emperor John Zimisces here routed the Russians under Sviatoslav. It was besieged by the Russians in 1773, and again in 1779, when they suffered a severe loss. It capitulated to them in 1810. In 1828 they besieged it for several months, and were obliged to retire; but in 1829 it was reduced by them, and held for some years as a pledge for the payment of an indemnity by the Porte, but was eventually returned. In 1849–'53 the fortifications were greatly strengthened by the addition of 12 detached forts, of which that on the hill commanding the town is one of the best military works of the time. In May, 1854, it was invested by Gortchakoff, and afterward by Paskevitch; but after bombarding it for 39 days the Russians retreated with a loss of about 12,000 men and most of their armament. During the siege the town was laid in ruins by the Russian batteries and mines.

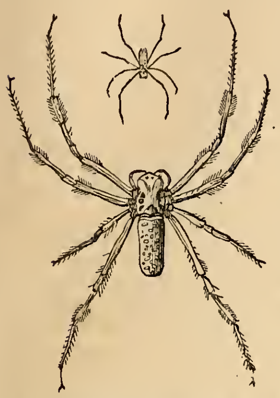
**SILK**, a fibre obtained chiefly from the cocoons of the caterpillar of the mulberry tree moth (*bombyx mori*). The fibre produced by other species of the genus *bombyx* and by other genera of the same family is inferior to that of *B. mori*. For an account of these silk-producing insects, see SILKWORM. The spider's thread resembles silk in character, but the rearing of spiders is so difficult, and the produce of each individual so small, that all attempts to convert the fibre into textile fabrics have been abandoned. The byssus of the *pinna nobilis*, a shell fish inhabiting the Mediterranean, consists of long, silken filaments, which have sometimes been woven into fabrics, but rather for curiosity than for use. The manufacture of silk doubtless originated in China. It is asserted by Chinese historians that the wife of the emperor Hwang-ti (about 2600 B. C.) was the first who unwound the silkworm's cocoon. As early as the time of Aristotle silken fabrics were woven in the island of Cos, but the fibre there employed appears to have been imported from the country of the Seres (Chinese). Later the product of the Coan looms was famous throughout the Roman empire as *Coa vestis*, a transparent gauze. The silkworm was unknown to Europe prior to the reign of Justinian (A. D. 527–565), when some "grains" or eggs of the insect were brought to Constantinople by two Persian monks, the introduction of the white mulberry following soon after. The silk manufacture made rapid progress, its chief centres being Thebes, Corinth, and Argos. In 1147 many inhabitants of Grecian cities who were skilled in this art were taken prisoners by Roger, king of Sicily, and carried to Palermo. The silk industry soon spread into Italy, and Venice, Milan, Florence, and Lucca were distinguished for the excellence of their fabrics. The Moors at an early period introduced the manufacture into Spain, and a flourishing silk trade was already established at Granada when that city was captured by Ferdinand the Catholic. Louis XI. of France in 1480, and Francis I. while the French occupied Milan in 1521, introduced workmen from there for the purpose of establishing the production of silk in France; but the attempts were not successful till 1564, when a gardener at Nîmes had cultivated the white mulberry trees and prepared suitable food for the worms. The silk manufacture had a rapid development in the south of France, and England began to import thence costly fabrics, such as she had previously imported from Italy and China. The manufacture of silk goods made great progress in England during the reign of James I., and it is said that in 1666 the trade had become so important as to give employment to 40,000 persons. In 1685 a large body of silk weavers, driven from France by the revocation of the edict of Nantes, took refuge in England and settled in Spitalfields, London, where they established several new branches of the art. In 1783 the value of the silk products was rated at £3,350,000. James I. early sought to establish silkworm culture in the American colonies. He himself forwarded eggs to Virginia, and high rewards were offered with the hope of placing the culture upon a permanent footing. But it was all in vain; tobacco superseded silk. In Louisiana the cultivation of silk was introduced in 1718 by the "Company of the West." Government grants were made to the settlers in Georgia, to encourage the cultivation of the mulberry tree. Artisans were sent to that colony in 1732 from different parts of Europe to direct the management of the worms and winding of the silk, and trees, seed, and silkworm eggs were abundantly furnished. In 1734 the first export of raw silk, amounting to 8 lbs., was made to England. More was sent the next year, and being manufactured into organzine by Sir Thomas Lombe, it was much admired. At the German settlement of Ebenezer, on the Savannah river, the production in 1749 had amounted to over 1,000 lbs. of cocoons, and the silk was so well reeled that it commanded in London the highest prices. In 1751 the trustees of the Ebenezer settlement erected in Savannah a public filature or silk house, to instruct in the management of private filatures. At the end of 1754 the exports of raw silk for the four preceding years amounted in value to $8,880, and for the next 18 years the annual exports averaged 546 lbs. The cocoons delivered at the filature in 1757 were 1,050 lbs.; in 1760, 15,000 lbs.; and in the next eight years they amounted altogether to nearly 100,000 lbs. But when parliament in 1766 reduced the price of cocoons from 3*s.* (one half of which had been in the way of bounty) to 1*s.* 6*d.*, the production rapidly declined from 20,000 lbs. of cocoons in 1766 to

290 lbs. in 1770. The business was entirely broken up by the revolutionary war. In South Carolina silk growing was practised before the revolution by the Swiss settlers at Perrysburg, and also by the French, who wrought it up with wool into fabrics. In 1765, 630 lbs. of cocoons were raised upon a plantation in St. Thomas parish; but though some progress continued to be made in the business, it was at last brought to an end by the same causes that broke it up in Georgia. In Connecticut the culture of silk was also undertaken at an early period, and was encouraged by the home government as in the other colonies. Dr. Aspinwall succeeded in establishing the business in Mansfield, Conn., where it is still carried on, and before the revolutionary war it was already in a very promising condition. In 1789 about 200 lbs. of raw silk, worth $5 a pound, were made at Mansfield; it was mostly manufactured into stockings, handkerchiefs, ribbons, buttons, and sewing silk worth $1 an ounce. In 1790 about 50 families in New Haven were engaged in the business, and in Norfolk about 30 families raised and spun 1,200 "run of silk." In 1839 the product of Mansfield and its vicinity is reported to have been about five tons of raw silk. In Massachusetts attention was also directed to the silk culture in the latter part of the last century. The town of Ipswich was noted in the manufacture of silk and thread lace. A filature was opened in 1770 at Philadelphia, and 1771 from June to the middle of August it received 2,300 lbs. of cocoons. In some of the interior towns of Pennsylvania, as Washington in the S. W. part, silk is still produced to a moderate extent, and not only converted into sewing silk, but also woven. In Ohio, the E. parts of Kentucky and Tennessee, and N. Georgia, the production has proved well adapted to the soil and climate, and many have anticipated for it a great success in this portion of the country. There seem in fact to be no natural obstacles to the prosecution of the business over all the middle and southern portion of the United States. Several species of mulberry, quite as well adapted for feeding the worms in the early stages of their growth as the white mulberry, grow wild from Pennsylvania southward, and are easily cultivated in other districts. The foreign species of the tree have also been introduced, and are now almost as well known as the native sorts. The total product of silk raised in the United States in 1840 was reported at 61,552 lbs., worth about $250,000. In 1844, according to the report of the commissioners of the census, it was 396,790 lbs., worth $1,400,000; but in 1850 it was only 14,763 lbs. The United States census of 1870 gives no statistics of native silk culture; neither is there any mention of American silk in the "Report of the Silk Association of America" for 1875. The growth and manufacture of silk have been successfully attempted in California. Just before the breaking out of the Franco-German war, French coöperation had been secured for the establishment of a silk colony in San Bernardino co.; but the project failed, owing to the disastrous termination of that conflict. There was in San José in 1875 one cocoonery with about 1,000,000 silkworms, and a silk manufacturing company has been organized in San Francisco. In the same year Sonoma co. had an association for the promotion of silkworm culture.—SILK MANUFACTURE. The cocoons consist of the sheath of loose filaments attached to the twigs that support the whole, and beneath this the external coat of soft flossy silk, within which is the compact oval ball, or cocoon proper. The thread, as laid by the worm in successive coats in his constantly diminishing tenement, is not wound regularly around the inside of the hollow ball, but is passed back and forth in one place after another in such manner that many yards may be wound off without turning over the ball. It is produced through two orifices in the nose of the worm, and the two fibres on issuing forth are secured together by the glutinous matter which accompanies them and forms nearly one quarter of their weight. The average size of each one of the primary fibres is about $\frac{1}{2000}$ of an inch. Raw silk consists of any number of the double filaments slightly twisted and agglutinated together to form one thread, called single. This is commonly of a golden yellow color, of specific gravity 1·3, and is the strongest of all fibres used for weaving, threads made of it being three times stronger than those of the same size made of flax, and twice as strong as those of hemp. Some of the best cocoons are kept for breeding; the remainder are classified, each sort being worked by itself. Before the chrysalis matures and the moth can begin to eat his way out, the cocoons are exposed to a moderate degree of heat, either in an oven, or in a steam bath, or in water heated to about 200° F. The floss covering being opened at one end, the cocoon is slipped out, and is then ready to be unwound. The cocoons are placed about five together in each one of four compartments in a sort of trough or basin holding hot water, which is kept at the necessary temperature by a steam pipe. The gummy matters are softened by the water, and the fibre is thus released. The ends are caught up by a little sort of broom with which the cocoons are stirred, and those from each compartment being brought together are passed through an eyelet, which strips off a portion of the gum, and still more is rubbed off by causing the threads formed by each bundle of fibres to cross and rub against each other, as they are conducted diagonally through a succession of eyelets toward the reel, just previous to reaching which all are united in one thread. The reel is set at some distance from the trough, to allow the gum to harden, and prevent the threads from sticking together; and it has a slight lateral motion, so that the threads are laid in spirals, and do not come in

contact while fresh from the bath. When a thread breaks, or a cocoon gives out, a fresh cocoon is substituted; and as the inner fibres are always much finer than the outer, new cocoons are added before the first lot have been unwound. These finer filaments, as also the immediate envelope of the chrysalis, constitute with the floss silk what is known as waste. The raw silk taken off from the reels is in China made up into bundles, called books, for exportation, and elsewhere the hanks are simply twisted so as to hold snugly together. They are then ready for the factory of the silk throwsters, where are conducted the operations connected with the throwing, a term variously used to express the putting a twist into fibres. For bandanna handkerchiefs the only preparation of the silk is winding the hanks and cleaning; bleaching is added for silk intended for gauze and similar fabrics. Winding, cleaning, and throwing prepare it, under the name of thrown singles, for ribbons and common silks. If simply doubled before throwing, it is known as tram, and is used for the woof or shoot of gros de Naples, velvets, and flowered silks. The twisting of each strand before doubling, as well as afterward, converts it into organzine, a streng thread suitable for warp. The winding is done from light six-sided reels called swifts, upon which the hanks, first washed in soap and water, are extended, and rows of which are set upon long shafts in an iron frame and connected each with its own bobbin, upon the top of the frame. The revolution of the latter carries around the reel beneath, and the movement is properly checked and regulated by appliances to the reel. The next process is that of cleaning the threads, which is effected upon the cleaning, drawing, or picking machine. The full bobbins are set horizontally upon plain spindles, from which each thread is conducted over an iron or glass guide rod, thence through an adjustable opening between two upright iron blades of an instrument called the cleaner, and then to the empty bobbins, which by their revolution wind it off from the full ones. Knots and other irregularities are stopped by the cleaner, and if not brushed off they stop the movement of the bobbin until they are removed by hand. The spinning or rather twisting process is conducted by means of machines similar to those used for the same purpose in cotton spinning. Doubling is the process of bringing two or more of the twisted threads into one and winding this. The bobbins of doubled thread are next twisted at the spinning frames, which completes the preparation of silk thread whether for sewing or weaving purposes. The American machines for doubling and twisting are much superior to those used in England, but for winding the same are employed in both countries. The thread is colored by dyeing after the gum has been removed from it by boiling for three or four hours in soap and water. It loses about one quarter its weight by this operation, but recovers nearly half the loss in the dye stuff it absorbs.—Waste silk is prepared for spinning by first hackling in the same manner as flax is hackled, and with the same sort of hand instrument. This is followed by machine hackling upon the filling engine, which more effectually combs out the filaments and removes the impurities. The sliver of parallel fibres is then chopped into lengths of about 1¼ in., which after scutching, as in the treatment of cotton, are converted into a sort of fine down. This is put into bags and boiled, first with soap and water for an hour and a half, and afterward with pure water. It is then powerfully squeezed under a Bramah press, dried by artificial heat, and again scutched. The succeeding operations of carding, drawing, and roving by the fly frames, and spinning by the spinning mill and throstle frames, are similar to those practised in the manufacture of cotton yarns. The product is adapted for the manufacture of shawls, bandanna handkerchiefs, and similar fabrics.—In the year ending Dec. 31, 1874, there were in the United States 180 silk manufactories, employing 14,479 operatives of both sexes, distributed as follows: New Jersey 42, with 5,414 operatives; New York 70, with 3,378; Connecticut 21, with 2,651; Pennsylvania 23, with 1,541; Massachusetts 11, with 1,249; California 3, with 100; Ohio 3, with 40; Illinois 2, with 35; New Hampshire, Maryland, Vermont, Missouri, and Kansas, each 1. The total capital invested was $14,708,184; total value of production, $20,082,482. Of this sum, thrown and spun silks amounted to $3,863,325; sewing silks and machine twist, $5,766,684; broad goods and ribbons, $6,154,-313; laces, braids, and trimmings, $4,298,196. The importations of silk into the United States for the year ending June 30, 1875, were as follows: raw silk, 1,101,681 lbs., costing at the foreign port of shipment, $4,504,306; sewing silk, $30,389; silk, satins, crapes, pongees, plushes, ribbons, &c., $19,226,672; gloves and hosiery, $71,053; mixed goods, $3,482,369; total, $27,314,787. There were imported besides 398,012 lbs. of cocoons. The silk crop of Europe in the year 1874–'5 was 9,000,000 lbs., of which Italy supplied 6,300,000, France 1,600,000, and Spain about 310,000. The import from Asia amounted to 11,500,000 lbs.

**SILK SPIDER** (*nephila plumipes*, Koch), a geometric spider of the family *epeiridæ*, first brought to notice by Dr. B. G. Wilder in 1865; he discovered it on the sea islands off the coast of South Carolina. The female is 1·1 in. long, with a longitudinal spread of legs 2¾ in., and a lateral extent of 3¾ in.; the cephalo-thorax is black above, mostly covered with silvery hairs; abdomen olive brown, with yellow and white spots and stripes; eye spots black and eight in number; it received its specific name from the closely set stiff brushes of hairs on the legs. They are found in forests, building strong viscid webs, 3 to 4 ft. in diameter, and usually over 10 ft. from the ground. The web

is made of a dry, inelastic, silvery gray silk, and of a very elastic, viscid yellow silk; the former is the supporting radiating framework, and the latter forms the concentric entangling circles. It sucks out the gum of its old web for making a new one; this is a circle minus its upper sextant, consisting of a continuous spiral viscid line laid upon the numerous radii. The spider remains quiet in its web, head downward, and is very active upon it when a fly is entangled; it is slow on the ground, and likes the full glare of the sun. The web is never vertical, but inclined at an angle of 70°; when it is touched, it shakes its web violently. Like most if not all geometric spiders, though well provided with eyes, it can distinguish only light; if the insect caught happens to be on a radius beyond her reach, she cannot see it, and returns to the centre to shake the web and ascertain what radius holds the weight; two spiders will often approach each other till their legs interlock before they are aware of their proximity. Hearing and touch are acute. The males are only a quarter of an inch long, with the legs spreading laterally and longitudinally about three fourths of an inch; the body and legs are dark brown; they make no webs, unless when very young, and seem to hang on to that of some female, or to some part of her body. Prof. Wilder had an idea that the silk of this spider might be useful in the arts, and devised several ingenious ways to procure it. He found that from one pair of spinners came white and from another yellow silk, which he was enabled to wind separately by a simple machine to the extent of nearly two miles, at 170 revolutions a minute, in less than five hours of winding time; he could not reel more than 300 yards at one time; the diameter varied from $\frac{1}{6000}$ to $\frac{1}{1000}$ of an inch, and its strength was very great. For details see the "Popular Science Monthly" for April, 1875.



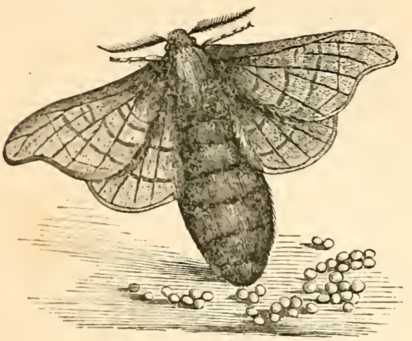
Silk Spider, Male and Female, one half the natural size.

**SILKWORM,** the larva of a lepidopterous insect of the moth division, family *bombycidæ*, and genus *bombyx* (Schrank). Of all the silk-producing larvæ, that of the common silkworm (*B. mori*, Schr.) is the most important, as from it is obtained all the European and most of the Chinese silk. The moth is about an inch long and 2 in. in alar extent, of a whitish or pale yellowish color, with two or three obscure streaks and a lunate spot on the upper wings; the trunk is very short; the superior wings decumbent, and the inferior extending almost horizontally beyond them; the antennæ of the males are pectinated; the males fly swiftly in the evening and sometimes by day, but the females are inactive; the latter live but a few hours after the eggs are deposited on the mulberry trees. The eggs are about the size of mustard seeds, and the young emerge in a few days if the weather or air of the breeding room is warm and dry; when first hatched they are one or two lines long, of a dark color, and very soon begin to eat voraciously, with short intervals of abstinence during the moultings, until full grown, when they are about 3 in. long, light green with darker marks, with blackish head, and fleshy protuberance on the last joint but one; there are 12 segments to the body, 9 stigmata or breathing holes on each side, and 16 legs, of which the anterior 6 are hooked, and the others, including the 2 on the last segment, end in disks;

Larva, Pupa, Cocoon, and Moth of Bombyx mori.

Silkworm Moth, Male.

the mouth has a vertical opening, with strong and serrated jaws; the stomach is very large, as would be expected in such a voracious larva. It lives exposed in the wild state, but none of the Chinese or European worms are allowed to incur the risks of life in the open air. According to the experiment of Count Dandolo, 100 newly hatched silkworms weigh 1 grain, after the first moult 15, after the second 94, after the third 400, after the fourth 4,628, and at full size 9,500 grains; each consumes an ounce of mulberry leaves during these stages, about 60,000 times its primitive weight, and its length increases from 1 to 40 lines during the same period; by calculation the product of an ounce of eggs eats upward of 1,200 lbs. of leaves, and should furnish 120 lbs. of cocoons. Like most other caterpillars, it changes its skin four times, at intervals depending on the temperature and on the quantity and quality of the food; if kept at 80° to 100° F. it moults in half the time required at ordinary temperatures. As usually treated, the first moult takes place on the 4th



Silkworm Moth, Female.

or 5th day after hatching, the second begins on the 8th, the third takes up the 13th and 14th, and the last happens on the 22d or 23d day; after this the fifth age lasts 10 days, making about 32 days for the whole process to maturity. The appetite increases with the size till after the fourth moult; during the last 10 days the silk gum is elaborated, the appetite diminishes, and the larva begins to spin its cocoon. The spinning apparatus is near the mouth and connected with the silk bags, which are long, slender, and convoluted, containing a liquid gum; they are closed below, and end above in slender tubes, one on each side, which unite to form the single spinning tube; the gum from which the silk is produced on contact with the air is elaborated by the long glandular organs; every thread of silk is made up of two strands. It is customary to supply to the worms a piece of rolled paper or some hollow substance into which they can retire, or a convenient twig, for the formation of the cocoons. They first make an outer covering of floss silk to keep off the rain; within this they spin fine silk, bending the head and body up and down and crossing to every side, entirely surrounding the body as a protection against wind and cold; and within this is a more delicate silk, glued firmly together for the inner chamber, resisting both cold air and water. After building the cocoon the larva is transformed into a chrysalis, and comes forth a moth, easily bursting through the case, the silk, and the floss. The cocoon resembles a pigeon's egg, and is from 1 to 1½ in. long, and bright yellow; the moth emerges from it in from 15 to 56 days, according to temperature, the former being the time in the southern United States; 18 to 20 days is the time in Connecticut, three weeks in France, and five to six weeks in England; the cocoon is made in from a few hours to three days, and is more pointed at one end than the other; the silk is not interwoven nor the glue applied at the pointed end, toward which the head is always placed. The chrysalis has no spines nor serrations on the edge of the abdominal rings, has a leathery skin, and the stomach filled with a yellowish nutritive fluid; the organs of the moth are gradually developed, and in two or three weeks the skin of the chrysalis gives way, the moth escapes into the cocoon chamber, and readily sets itself free, leaving within the remains of its former covering. In the wild state the cocoon is made about the middle of June. The silk from the cocoons containing males is finer and more tenacious than that from the female cocoons. It is fortunate that the threads do not adhere as they do in the cocoons of many other larvæ, else the operation of unwinding would be very difficult if not impracticable; even in the *B. mori* the silk is sometimes coarse and adherent, when the quality of the food has not been good. Like other caterpillars, the silkworm sometimes makes mistakes, and two or three are occasionally shut up in a single cocoon, in which they undergo metamorphosis perfectly well. The usual way of throwing the cocoons into boiling water kills the chrysalis; but merely steaming them over boiling water softens the glue sufficiently to allow the unwinding of the silk, and permits the moth to come forth alive from the interior layer and deposit the eggs or prepare for a new brood.—The whole secret in raising the silkworm consists in securing for it warmth, dryness, plenty of proper food, and pure air. The mulberry tree, the leaves of which constitute the food of the silkworm, requires for its perfect growth long continued dry and warm weather, and suffers in the rainy seasons of England and France; it is said to have no insect feeding upon it but the *bombyx;* it exhausts the earth where it is planted, as far as any other vegetation is concerned; one tree of the *M. multicaulis*, it is computed, will feed as many silkworms as would produce annually 7 lbs. of silk. Silkworms are very tender and liable to perish from slight changes of temperature and dampness, from foul air, and im-

proper or insufficient food; the periods of the moultings are times of sickness and danger; great destruction is caused by a disease called muscardine, which is a minute fungus (*botrytis Bassiana*) occupying the interior of the body and bursting through the skin. The disease called the "reds," manifested by red stains and blotches on the skin, is ascertained to be due to some acid, resulting from disordered digestion; the larvæ seem cramped and stupefied, the rings dry up, and they look like mummies.—The larvæ of several large moths of the genus *saturnia* (Schr.) form cocoons from which silk is obtained; among these are the arrindi silkworm, *S.* [*Samia*] *Cynthia* (Schr.), of India, and the *S. mylitta* (Schr.), whose moths have an alar expanse of about 8 in., and appear to be the wild silkworms of the East. The *S. mylitta* abounds in Bengal, and yields much coarse and dark-colored silk, highly prized by the Hindoos; it cannot be domesticated; the natives catch the caterpillars, put them on the asseem trees, and guard them from birds by day and bats by night; the natural food is the *rhamnus jujuba.* The *S. Cynthia* is domesticated in the interior of Bengal, on leaves of the castor oil plant (*ricinus communis* or *palma Christi*) and of the *ailantus glandulosa;* the cocoons are generally about 2 in. long and 3 in. in circumference, whitish or yellowish, of soft and delicate texture. There are eight or ten species of American silkworms; the *callosamia Promethea* and *C. angulifera* feed on the lilac and wild cherry; others are *platysamia Euryale*, *P. Columbia*, *P. Cecropia*, and *tropæa luna;* but practically the larva of *telea Polyphemus* is the only important one. This feeds on the leaves of the oak, maple, elm, willow, and several other trees. For descriptions and figures of this species, in all its stages, and the method of rearing the larvæ, see "American Naturalist," vol. i., 1867.

**SILLIMAN. I. Benjamin**, an American physicist, born in North Stratford (now Trumbull), Conn., Aug. 8, 1779, died in New Haven, Nov. 24, 1864. He graduated at Yale college in 1796, was appointed tutor in 1799, and was admitted to the bar in 1802. He accepted the new chair of chemistry at Yale college in 1802, and passed a part of the next two years in Philadelphia, as a student with Dr. Woodhouse. In the winter of 1805 he gave his first full course of lectures, and shortly after sailed for Europe. He visited the mining districts of England, attended lectures in London and Edinburgh, and resumed the duties of his professorship after an absence of 14 months. He published in 1810 "Journal of Travels in England, Holland, and Scotland in 1805–'6" (2 vols. 8vo; enlarged ed., 3 vols. 12mo, 1820). Not long after his return he made a geological survey of a part of Connecticut. In December, 1807, a meteorite of great size and splendor passed over New England, and threw off large fragments with loud explosions in the town of Western, Conn. Profs. Silliman and Kingsley visited the town and procured some fragments; and Silliman made a chemical analysis and published the earliest and best authenticated account of the fall of a meteorite in America. He afterward assisted Dr. Robert Hare in his experiments with the oxyhydrogen blowpipe, to which he gave the name now commonly used of "compound blowpipe." In 1813 he published in the "Memoirs of the Connecticut Academy of Arts and Sciences" an account of his experiments with this instrument, by which he had greatly extended the list of bodies known to be fusible. In 1812 he secured to Yale college the then unrivalled mineralogical and geological collection made by Col. George Gibbs in Europe. In 1822, while engaged in a series of observations on the action of a powerful voltaic deflagrator on the model of Dr. Hare, he first established the fact of the transfer of particles of carbon from the positive to the negative electrode of the voltaic apparatus, with the corresponding growth of the negative electrode, and the retransfer when the charcoal points are shifted. In 1818 he founded the "American Journal of Science and Arts," better known both in Europe and America as "Silliman's Journal," of which for 20 years he was sole, and for eight years more senior editor. He was one of the earliest American lecturers on scientific subjects to miscellaneous audiences, and delivered courses in the principal cities. He published an account of a journey between Hartford and Quebec (1820), an edition of Bakewell's "Geology" (1829), and a text book on "Chemistry" (2 vols., 1830). In 1851 he again visited Europe, and published "A Visit to Europe in 1851" (2 vols. 12mo, New York, 1853). In 1853 he resigned his professorship, and was made professor emeritus; but at the request of his colleagues he continued to lecture on geology till June, 1855. His life has been written by Prof. George P. Fisher (2 vols., New York, 1866). **II. Benjamin**, jr., an American physicist, son of the preceding, born in New Haven, Conn., Dec. 4, 1816. He graduated at Yale college in 1837, became an instructor there in chemistry, mineralogy, and geology, and in 1846 was appointed professor of chemistry applied to the arts in the scientific school of the college, now the Sheffield scientific school. He became associate editor of the "American Journal of Science" in 1838, and since 1854 has been associated with Prof. J. D. Dana as editor and proprietor. From 1849 to 1854 he was professor of medical chemistry and toxicology in the university of Louisville, Ky.; and in 1854 he succeeded his father as professor of general and applied chemistry in Yale college, which post he still holds (1876). In connection with C. R. Goodrich he prepared the "Illustrated Record" and the "Progress of Science and Art" published in connection with the international exhibition of 1853 in New York. He was for several years secretary of the American association for the advancement of science, and had charge of the

publication of its "Proceedings." He is also a popular lecturer. Besides numerous papers in the "American Journal of Science," he has published "First Principles of Chemistry," a popular text book (Philadelphia, 1846; revised ed., 1856), and "Principles of Physics" (Philadelphia, 1858; revised ed., 1868).

**SILLOWAY, Thomas William**, an American architect, born in Newburyport, Mass., Aug. 7, 1828. He began to practise his profession in Boston in 1851, and in the 20 years following more than 200 church edifices were built or remodelled under his superintendence. He designed the new capitol, Montpelier, Vt. (1859), Buchtel college, Akron, O. (1872), &c. While pursuing his profession as an architect, he acted as a Universalist preacher from 1852, and was ordained a clergyman in 1862. He has published "Theognis, a Lamp in the Cavern of Evil" (Boston, 1856); "Text Book of Modern Carpentry" (1858); "Warming and Ventilation" (1860); "Atkinson Memorial," a series of 18 discourses (1861); "The Conference Melodist" (1863); "The Cantica Sacra," a book of church service (1865); and "Service of the Church of the Redeemer" at Brighton (1867). With George M. Harding he edited an improved edition of Shaw's "Civil Architecture" (1852).

**SILPHIUM** (Gr. σίλφιον, the ancient name of some resin-bearing plant), a genus of coarse, robust, perennial plants of the composite family, which have a copious resinous juice and large heads of flowers, resembling those of the sunflower, but quite different in structure. In *silphium* the numerous ray flowers are pistillate and fertile; those of the disk, though they are apparently perfect, are sterile; the broad flat akenes are winged and without pappus. The genus comprises about 20 species, all North American; some are very abundant on the western prairies, while others are peculiarly southern. The best known species is *S. laciniatum*, called rosin weed; it has a large thick root, from which arise numerous radical, long-petioled leaves, from 12 to 30 in. long; they are very thick, and rough with bristly hairs; their general outline is ovate, but they are deeply pinnately cut and parted, and the divisions themselves often cut-lobed; the stem, usually 3 to 6 ft. high, sometimes reaches 11 ft., and bears near its base numerous leaves similar to those from the root, and fewer leaves above. The flower heads, borne in a kind of raceme at the upper part of the stem, are 3 to 5 in. across, and, as in all the other species, yellow. The resinous juice of this and others exudes either spontaneously or from the puncturing of insects, appearing in small translucent tears upon the stem and foliage. This resin and the plant itself have been regarded as useful remedies in asthma and similar diseases of horses. A tincture of the root and leaves is sometimes used as a domestic tonic and diaphoretic. The erect leaves of this plant, when growing in the open prairie, commonly stand with their edges pointing north and south; hence it has been called compass plant, pilot weed, and polar plant. This species occurs from the prairies of Michigan southward and westward. A closely related species, found from Ohio west and south, called prairie burdock or prairie dock, is *S. terebinthinaceum*, having also large and coarse leaves, which are not cut, but only serrate on the margins, and rough and scurfy especially on the under surface; the tall stems are smooth, and the heads of flowers are smaller than in the preceding. This species produces resin abundantly, the leaves being often sprinkled with it. One of the most striking species is *S. perfoliatum*, called the cup plant; its square stem bears opposite leaves, a foot or more long; these are united by their bases around the stem, and form a concave disk, which after a rain contains a considerable quantity of water. This has a similar geographical range to the preceding, but having long been cultivated in gardens on account of its curious leaves, it has been introduced much further east.


Rosin Weed (Silphium laciniatum).

**SILURIAN**, the name of one of the geologic ages, the age of mollusks and other invertebrates. The name is derived from that of the ancient Silures, who inhabited that portion of England and Wales where these rocks abound. The formation lies upon the Cambrian of Sedgwick, according to some classifications, and immediately below the Devonian. Murchison includes in it the upper Cambrian of Sedgwick. The subdivisions of the Silurian age differ in Europe and America, and also in different parts of the same continent. In North America the transition of the rocks and life from the lower to the upper Silurian is abrupt. In Great Britain the transition in life is gradual, although the rocks are unconformable in stratification. In Bohemia there is no break in the rocks, but there is marked change in the life. Dana has adopted the subdivision into periods and epochs derived from the succession of rocks in the state of New York, where the strata are well displayed, and have been carefully studied. In this arrangement the lower Silurian, beginning from below, includes the primordial or Cambrian, the Canadian, and the Trenton periods; the upper Silurian embraces, in the same ascending order, the Niagara, Salina, lower Helderberg, and Oriskany periods. The Oriskany formation was until recently placed as the lowest period of the Devonian age; but from

the relations of its fossils it has been transferred to the Silurian. The Cambrian period has two epochs, the Acadian and the Potsdam. The Canadian period has the calciferous, the Quebec, and the Chazy epochs. The Trenton period embraces the Trenton, Utica, and Cincinnati epochs; the Niagara period, the Medina, Clinton, and Niagara epochs; while the Salina, lower Helderberg, and Oriskany periods have each one epoch, correspondingly named. The lower Silurian animal fossils are sponges, radiates, mollusks, and articulates; among the last are numerous trilobites, a species of which found near Braintree, Mass., in the Acadian formation, was 20 in. long. The calciferous and Quebec epochs of the Canadian period are remarkably rich in fossils and economic products, the latter including copper and silver ores. In Newfoundland the Quebec formation reaches a thickness of 6,600 ft., the upper half being sandstone and shales and the lower half mostly limestones. The Trenton period, abounding in fossils and economic products, among which is petroleum, has its formation along the Appalachians and over a large part of the Mississippi basin, including the galena limestone of Wisconsin and other states. Trenton limestone has been found in the arctic regions, upon King William's island, North Somerset, and Boothia. The Niagara formation in North America covers a large part of the interior of the continent, and the arctic and other parts of British America, and also contains petroleum. At Niagara falls 85 ft. of limestone rest on 80 ft. of shale, and near the falls the shale is covered with 165 ft. of limestone. The Salina period includes the rocks which yield the salt brines of central New York. Through the Mississippi basin the Salina formation is for the most part absent. This formation contains numerous beds of gypsum, which are not stratified like the other rocks, and have been formed by the action of sulphuric acid upon limestone, the sulphuric acid being derived from sulphur springs. The Oriskany period contains no land plants in New York, but at Gaspé, province of Quebec, a small species of *lycopodium* or ground pine has been found. The most common animal fossils are bivalve mollusks. In Maryland there are five species of crinoids, but in New York they are rare. The rocks of both the lower and upper Silurian are widely distributed over the globe, although the lower are the most extensive. The upper Silurian in Europe, besides invertebrate fossils, contains the vestiges of the earliest fishes, some of which are of the shark tribe; so that although the Devonian is the age of fishes, they really originated in the Silurian. It was formerly thought that the Silurian formation contained the earliest vestiges of organic life, but organic remains have recently been found in older formations. (See GEOLOGY, vol. vii., p. 694, and PALÆONTOLOGY, vol. xii., pp. 811, 813, 816.)

**SILVER,** one of the precious metals, distinguished by its whiteness, its brilliant lustre when polished, its malleability, and its indifference to atmospheric oxygen. It is one of the most widely distributed of metals. Since it occurs frequently in a native state (though never chemically pure, being invariably alloyed with gold or copper, and sometimes antimony, arsenic, bismuth, quicksilver, or iron), and is easily fusible, it naturally became known to mankind in the earliest ages. The alchemists called it *Luna* or *Diana*. The Greek name ἄργυρος is from ἀργός, white, and is the source of the Latin *argentum*. Silver is one of the first metals named in the Old Testament, being included among the enumerated riches of Abraham. At that period, as in later times, it was used as a medium of exchange and as a material in the arts. In Solomon's reign it is said to have been so abundant as to be nothing accounted of, and the king had made it to be as stones in Jerusalem. Among other ancient nations it was also abundant. Polybius says the tiles upon the roof of the temple at Ecbatana were of solid silver, and the beams and pillars of the temple were covered with plates of silver and gold. These metals were obtained from Nubia, Ethiopia, Attica, Epirus, and the distant countries of eastern Asia. The rich Spanish silver mines were developed at an early day, and furnished the main supply of the metal for Phœnicia, Carthage, and Rome. Pliny speaks of a mine opened by Hannibal, which supplied him with 300 lbs. of silver daily, and was worked by adits reaching a mile and a half into the mountain. This was at Guadalcanal, at the foot of the Sierra Morena, in the modern province of Seville.—Pure silver, in its massive state, is the whitest of metals. It takes by burnishing a brilliant lustre, though inferior to that of its white alloys with copper. When granulated by falling molten into water, it acquires a rough but exceedingly beautiful surface. Reduced from the chloride in the humid way, it appears as a gray, spongy powder. It crystallizes in cubes and octahedrons when allowed to cool from the molten condition or precipitated from solution—for instance, by copper or zinc. Sometimes it is precipitated black by the galvanic current or by zinc. In hardness and strength it is superior to gold and inferior to copper; a slight alloy of copper hardens and strengthens it. In malleability and ductility it is inferior to gold only. (See METAL.) Leaves less than $\frac{1}{100,000}$ of an inch thick can be obtained by beating, and wires may be drawn out of extreme tenuity. Its chemical symbol is Ag, its equivalent 108. According to G. Rose, the specific gravity of cast silver is 10·505, of pressed or hammered silver 10·566. Other authorities give for the former 10·474, and for the latter 10·510. Lengsdorf found the specific gravity of silver wire which had been repeatedly drawn to be 10·47 before heating and 10·43 afterward. The specific heat of silver is given by Regnault as 0·057. Its heat-conducting power is greater than that of any other metal, as is also its power of reflecting

light and heat when highly polished; but its radiating capacity in the same condition is very small. By virtue of these properties vessels of silver are best adapted to retain the heat of liquids. It melts at a full red heat, about 1000° C. (1832° F.). It shrinks in cooling, and hence fills but imperfectly the moulds in which it is cast. At a very high temperature it is volatile. Melting silver mechanically absorbs 20 volumes of oxygen, which in solidifying it expels, sometimes with sufficient force to throw off particles of metal. Alloyed with 1 or 2 per cent. of copper or with gold, it apparently loses this property. Silver is oxidized neither by exposure at ordinary temperature to dry or moist air, nor by heating in air; but it burns to an oxide when melted upon charcoal in the oxyhydrogen flame, or when exposed to a galvanic current of great intensity, or to ozone. Chlorine, bromine, and iodine act upon it at ordinary temperatures. It has strong affinity for sulphur (with which it can be easily fused to a sulphide), and is hence readily tarnished by sulphuretted hydrogen, which is present in small quantities in the ordinary air of cities. To protect silver vessels not in use, they may be wrapped in paper saturated with wax, which keeps out the impure air, or in paper painted with white lead, which decomposes sulphuretted hydrogen. Articles of food, with the exception of eggs and salt, scarcely affect silver, and it is therefore a favorite material for table ware. The discoloration from eggs is due to sulphur; that from salt, to chlorine, which forms argentic chloride. This may be removed by rubbing with a linen rag moistened with aqua ammoniæ. The caustic alkalies in solution or fusion do not attack silver as they do platinum, and it is consequently employed for the evaporation of such solutions, and for crucibles in which minerals are fused with potassium or sodium hydrate. Silver foil is sometimes used in blowpipe analyses, for detecting sulphur and the sulphides of the metals. Melted with carbonaceous matter, silver forms a carburet, white like the metal. This is also formed when compounds of silver oxide are decomposed by organic acids.—Silver may be easily alloyed by melting with most metals. The alloys with base metals are in general not useful enough to counterbalance the cost of the silver. The alloy with copper, which in subordinate quantity enhances the valuable qualities of the silver, is an exception. The alloys with lead and zinc, serving an important purpose in metallurgy, will be mentioned further on. An alloy of 100 parts of aluminum with 5 of silver gives a handsome white malleable compound, susceptible of high polish. A small quantity of iron, chromium, cobalt, or nickel imparts great hardness to silver. Steel may be made to retain about $\frac{1}{500}$ of its weight of silver, which is said to improve its quality; the alloy is called silver-steel. Combined with mercury, silver forms a most brilliant amalgam for mirrors. An alloy of 20 to 30 parts of silver with 30 of nickel and 50 of copper is said to be equal in all respects to the ordinary standard silver, which is 9 parts of silver with 1 of copper. Small coins have been made in Switzerland of an alloy of silver and copper with 10 per cent. nickel. Two parts zinc and one part silver give a ductile, white, fine-grained alloy. Three parts of silver to one of tin give a hard, and one part of silver to two of tin a soft alloy. Bismuth, antimony, and arsenic yield brittle alloys. The alloys of silver and copper are the most important of all, being used both in coinage and in the arts. The copper alloy is harder than pure silver, takes a finer polish, and wears better; and the white color of silver may be retained if the contents of copper do not exceed a certain proportion, while even those alloys containing a larger proportion of copper may be so treated by "pickling" in acid as to deprive them of copper on the surface, and thus restore their silver-white color. The standard silver for coinage, on the continent of Europe and in the United States, is a compound of 9 parts of silver to 1 of copper; in England, of 37 silver to 3 copper. For plate the legal fineness varies in different countries, or is, as in the United States, left to the choice of the manufacturer. In North Germany the usual fineness is inferior to that of coin.—Silver does not dissolve in any hydrated acids by taking the place of the hydrogen; on the contrary, hydrogen displaces it from the solutions of its salts and precipitates it in metallic form. Concentrated sulphuric acid oxidizes silver at boiling heat, forming argentic sulphate and sulphurous acid. Nitric acid, even when diluted with an equal bulk of water, acts rapidly upon silver, and at high temperature with great violence, argentic nitrate and nitric oxide being formed. A solution of chromic acid changes silver to a red argentic chromate. Muriatic acid, even at a high temperature, has little effect upon silver. Argentic oxide combines at high temperatures with silicic acid; hence, silver heated or melted with glass or other silicious compounds becomes oxidized and colors the mass yellow. All of the more easily oxidizable metals and many compounds susceptible of higher oxidation (so-called deoxidizing substances), as well as many organic substances, precipitate silver from solution. Silver forms three oxides: a suboxide, $Ag_4O$; argentic oxide, $Ag_2O$; and a peroxide (probably $Ag_2O_2$), which does not combine with acids. The second of these is of special interest as the basis of the salts of the metal. It is separated from the nitrate, or any soluble silver salt, by adding an alkaline solution, as a brown hydrated oxide, which parts with its water at 60° C. (140° F.), and with its oxygen at a red heat. Its solution in ammonia deposits on exposure to the air a black micaceous powder supposed to be a compound of silver oxide and ammonia ($Ag_2O, H_3N$), or amidide of silver ($AgH_2N$),

or nitride of silver ($Ag_3N$). It is terribly explosive, and is hence called fulminating silver (Berthollet's). This most dangerous compound may also be unintentionally produced by precipitating an ammoniacal solution of argentic nitrate by the addition of caustic potash. The chlorate of this oxide is likewise very explosive, as is also the fulminate proper (Brugnatelli's). (See EXPLOSIVES.) The sulphate is formed by treatment of the metal at a high temperature with concentrated sulphuric acid. Upon this reaction is based one method of separating silver and gold. (See GOLD.) The nitrate ($AgNO_3$) is the most important salt of silver. (See NITRATES, vol. xii., p. 463.) It is employed in the preparation of other compounds of silver, the most important of which is the chloride, produced by adding to the nitrate solution chlorine or a soluble chloride, such as common salt. It is a dense white flocculent precipitate, which under exposure to light turns first violet, then black, probably by partial reduction to subchloride. Chlorine restores the white color. The chloride is slightly soluble in boiling concentrated muriatic acid, more readily in strong solutions of chlorides, ammonia, alkaline cyanides, and hyposulphites; insoluble in water and dilute acids; scarcely affected by any oxygen acid, even concentrated sulphuric; reduced to metal by zinc, iron, copper, or any metal more oxidizable than silver, heated hydrogen, organic compounds containing hydrogen, alkalies and alkaline earths, and by heating upon charcoal before the blowpipe. The insolubility of the chloride in oxygen acids permits the precipitation of silver from solutions of almost all its salts by the addition of hydrochloric acid or of other chlorides, thus giving a convenient means of determining its presence or separating it from other metals. On the other hand, the solubility of the chloride in brine or sodium hyposulphite constitutes an important means of silver extraction by the humid method of metallurgy described below. This salt occurs in nature as an ore. It is used in photography, and its ammoniacal solution is employed to color mother-of-pearl. The bromide ($AgBr$) and the iodide ($AgI$) also occur in nature, the latter rarely. Their chemical relations are similar to those of the chloride, but the bromide is but slightly dissolved in dilute aqua ammoniæ, and the iodide scarcely at all. They likewise have the property of darkening by exposure to light. (See PHOTOGRAPHY.)—*The Metallurgy of Silver.* Silver is obtained partly from true silver ores, partly from other ores containing silver as an accidental or variable constituent. To the former class belongs the native metal, which is usually more or less alloyed with gold, and sometimes with other metals, as above remarked. The occurrence of gold and silver in variable natural alloy is so general that they may almost be said to constitute but one mineral species, ranging from silver with a slight trace of gold to gold with a slight trace of silver. Native silver is found in masses and in arborescent and filiform shapes in veins of quartz, calcite, &c., or as segregations accompanying other silver ores. The masses are sometimes crystalline, showing cubical and octahedral forms. Very pure silver occurs with the native copper at Lake Superior. The most famous masses of native silver, several of which exceeded 500 lbs., have been found at the mines of Kongsberg in Norway, of Freiberg, Schneeberg, and Johann-Georgenstadt in Saxony, and in the Bohemian, Hungarian, Peruvian, and Mexican mines. In the silver mines of Nevada, Idaho, and Utah it is not uncommon, though it has not been found in large masses. Silver amalgam occurs in small quantities in some European mines, and contains 26 to 35 per cent. of silver, the remainder being mercury. The variety known as arguerite, from Coquimbo in Chili, is an important ore in that region, and contains 43 to 63 per cent. of silver. The antimoniuret and the telluret of silver are comparatively rare. The most important silver ores are the chloride, the sulphide, and the combinations of sulphide of silver with other sulphides. The chloride of silver, or horn silver ($AgCl$), is a common ore in Chili, Peru, Mexico, and the western regions of the United States, particularly in certain districts of Nevada, and in the Owyhee district of Idaho. It has been met with in small quantities in many of the European mines. When pure, its composition is silver 75·2, chlorine 24·8. It has a waxy appearance, resinous lustre, and pearl-gray, greenish, whitish, or bluish color, turning brown in the air; hardness 1 to 1·5; sp. gr. 5·3 to 5·5. It occurs chiefly near the outcrops of argentiferous deposits as a product of the decomposition of other ores. In Chili and Peru, for instance, it is found in cubical crystals in the ferruginous gossan known as *pecos* and *colorados.* The bromide and iodide, which also occur in nature, closely resemble it, but are far more rare. The sulphide of silver ($Ag_2S$, silver glance, vitreous silver, or argentite), containing 87·1 silver and 12·9 sulphur, is, next to the native metal, the richest ore. It has a blackish lead-gray color, metallic lustre, and shining streak; H. 2 to 2·5; sp. gr. 7·196 to 7·365; is easily cut with a knife, and readily melts on charcoal before the blowpipe. It forms a considerable portion of the ores of the silver mines of Saxony, Bohemia, Hungary, Mexico, Peru, and the United States. It is commonly associated with other argentiferous minerals, and sometimes is finely disseminated through the gangue or the accompanying ores. The double sulphides of silver and antimony constitute a very valuable class of ores, of which the chief are: stephanite ($Ag_5SbS_4$), with 68·5 per cent. of silver and sometimes small quantities of iron, copper, and arsenic, having metallic lustre, iron-gray color, black powder, H. 2 to 2·5, sp. gr. 6 to 6·27, occurring in Saxony, Bohemia, Hungary, Mexico, and

Nevada, particularly in the Comstock lode; miargyrite ($AgSbS_2$), with 36·9 silver, steel-gray to iron-black, metallic lustre, dark cherry-red powder, H. 3, sp. gr. 5·2, occurring in Saxony, Spain, and Mexico; pyrargyrite ($Ag_3SbS_3$), dark ruby silver or antimonial silver blende, with 59 silver, sometimes a little arsenic, black or by transmitted light deep red, H. 2 to 2·5, sp. gr. 5·759, occurring in Saxony, Baden, Cornwall, Norway, Mexico, South America, and Nevada; and polybasite ($Ag_9SbS_6$), with from 64 to more than 72 silver, the antimony being partly and sometimes wholly replaced by arsenic, and the silver partly by copper or to less extent iron and zinc, color iron-black, streak black, H. 2·5, sp. gr. 6·2, occurring in the Hartz, Saxony, Hungary, Mexico, and Nevada. Proustite, or light ruby silver ($Ag_3AsS_3$), similar to pyrargyrite, except that the color is lighter and the antimony is replaced with arsenic, occurs in the same localities, but more rarely; it contains 65·4 silver. Copper silver glance or stromeyerite ($CuAgS$), with 53 silver and 31 copper, iron-black, black shining powder, H. 2·75, sp. gr. 6·2, occurs in Silesia, Chili, and elsewhere. The foregoing are the principal true silver ores. The chief argentiferous ores of other metals are those of lead, copper, and zinc. Iron pyrites and arsenical pyrites, as well as bismuth, cobalt, and nickel ores, may be argentiferous, but it is usually by reason of finely disseminated silver ores throughout their mass. Galena is always more or less argentiferous. In the United States, the galena of the Appalachian range and of the Mississippi valley is usually poor in silver, while that of the Rocky mountains and the interior basin to the Sierra Nevada is highly argentiferous. Oxidized ores are usually poor in silver, but the carbonate, &c., occurring in the limestone of New Mexico, Utah, and the Eureka district, Nevada, are exceptions, being smelted in large quantities for lead and silver. The peculiar ore known as stetefeldtite, which occurs abundantly in Nevada, is an oxidized but massive mineral containing antimony and other base metals, and often very rich in silver. The variable mineral or class of minerals known as tetrahedrite (*Fahlerz*, argentiferous gray copper, freibergite, tennantite, hermesite) seems to be a combination of metallic sulphides with sulphides of antimony and arsenic, or a sulphide of antimony and copper, in which the antimony may be partly replaced by arsenic, and the copper by iron, zinc, silver, and even, as in freibergite, lead, or, as in hermesite, quicksilver. The percentage of silver varies from a mere trace to 32 per cent. Pure zinc blende is usually poor in silver, but is frequently found in intimate association with true silver ores or native silver, and particularly with argentiferous galena; and in some notable instances the blende is richer than the galena. —The mechanical concentration of silver ores by water is attended with heavy loss, by reason of their usual association with base ores of nearly the same specific gravity, and their property of cleaving when crushed into fine scales and splinters or dust, which are usually carried away by the current. The yield of silver ores is generally rated in this country in ounces troy to the ton of 2,000 lbs. avoirdupois, or 29,167 oz. troy. About 1 per cent. of silver would be equivalent to 292 oz. to a ton. A yield of a little less than 3 oz. is represented by the decimal ·0001 or ·01 per cent. This small proportion will not pay for the mining and reduction of the ores; but where lead is produced containing ·01 per cent. of silver, the latter can still be extracted and saved by refining processes. (See LEAD.) The pig lead (variously called work lead, crude bullion, and base bullion), mainly produced from argentiferous galena, carries from 20 to 200 oz. of silver to the ton.—The methods of producing silver from ores and furnace products may be divided into three classes: smelting, amalgamation, and humid extraction. The smelting processes are mostly based upon the capacity of metallic lead, as well as its oxide and sulphate, to separate silver under fusion from its combinations, the liberated silver alloying itself with an excess of lead and accumulating in the metallic bath in the hearth of the furnace. The following chemical equations indicate the typical reactions of the lead smelting processes: $Ag_2S + Pb + xPb = Ag_2,xPb + PbS$; $Ag_2S + PbO = AgPb + SO_2$; $Ag_2S + PbSO_4 = Ag_2Pb + 2SO_2$. (See METALLURGY.) From the argentiferous lead thus produced the silver is obtained directly by an oxidizing fusion (cupellation), transforming the lead into litharge and leaving metallic silver upon the cupel; or the argentiferous lead is first submitted to treatment in a battery of melting kettles, in which at a low temperature a portion of the liquid mass crystallizes, while another portion, rich in silver, remains liquid; and the crystals being ladled from each kettle to the next, and there submitted to remelting and recrystallization, while the liquid is passed down the series in an opposite direction, the contents of silver are at last chiefly concentrated into a small quantity of so-called rich lead, which is then cupelled (the Pattinson process); or the silver is extracted from the molten lead by means of the superior affinity between silver and zinc, metallic zinc being added to the bath and the zinc-silver alloy rising to the surface and being skimmed off and submitted to further treatment by means of smelting, liquation, or distillation (the Parkes process, with the modifications of Cordurié, Flach, and others). In smelting argentiferous copper ores, the silver is often concentrated in a copper matte or black copper, which may then be smelted with lead, or treated in the humid way. The liquation of argentiferous copper consists in alloying it with a certain quantity of lead, and afterward heating the alloy above the melting point of lead, but below that of copper. The lead "sweats" out, carrying the silver with it, and leaving

behind the spongy copper. This process has almost everywhere given way to humid methods. (See COPPER, LEAD, and METALLURGY.)—The method of amalgamation, invented in Mexico in 1557 by Bartolomé de Medina, led to the enormous production of silver there and in South America during the next 200 years, and has remained substantially in extensive use ever since. The Mexican, known as the *patio* process, is suited to ores which contain native silver or silver chloride (bromide, iodide) and sulphide, and are measurably free from other sulphides and from arsenides and antimoniurets. The ore is first crushed and then ground fine in arrastras. If gold is present, 50 or 60 per cent. of it may be saved by introducing silver or copper amalgam into the arrastra. Ores containing pyrites, antimony, or arsenic are incompletely roasted, to break up the combination of silver with these elements. The presence of silver sulphide does not necessitate roasting as a preliminary for patio amalgamation. The fine paste from the arrastra is spread on the patio floor (of stone, calked boards, or asphaltum) in round heaps (*tortas*) about 0·3 metre high and 10 to 16 metres in diameter, containing each from 5,000 to 100,000 kilos; average, about 60 tons. The paste having stiffened by the evaporation of its water, from $2\frac{1}{2}$ to 10 per cent. of impure salt is added, according to the contents of silver in the ore. This is intermixed with shovels and subsequently by the treading of mules or men, and occasionally by means of kneading machines, with travelling wheels, set up in the torta. After one or two days the *magistral* is added; this is copper vitriol and salt, or rich oxidized copper ores mixed with pyrites which has been roasted with salt, or simply copper pyrites which has been so roasted. The quantity of magistral required varies according to the season, the temperature, and the quantity of the ore; it usually ranges from $\frac{1}{2}$ to 1 per cent. Its function is to cause certain reactions with the salt and the sulphide of silver and promote the formation of amalgam. Too much of it causes too high a temperature in the mass, particularly in winter; hence cold weather and poor ores require the smallest amount. After another treading, quicksilver is sprinkled over the torta by squeezing through a leather or canvas bag. The quantity used is six to seven times the weight of silver in the ore, sometimes much more. It is rarely added all at once; the usual practice is to give fresh quicksilver every alternate day, treading the mass for six to eight hours on each intervening day. The termination of amalgamation is observed by panning samples (see GOLD) from the torta, and examining the amount and condition of the quicksilver and amalgam. The period required for the whole operation down to this point varies from 5 to 30 days; average, about 19 days. Various theories have been proposed concerning the chemical reactions of the patio. Too low a temperature stops the reactions, and may be remedied by more frequent treading or by additional magistral. The amalgam is collected in settlers, which are circular vats of wood or masonry, about 9 ft. in diameter and 8 ft. in depth, in which the mass, thinned with water, is stirred and allowed to deposit its heavy amalgam, while the lighter portion is drawn off. The amalgam, being concentrated still further, is at last collected in a leather or canvas bag, where it is freed by squeezing from free mercury, which passes through, carrying a little silver with it, while the mass remains in a coherent, plastic condition. The former is used again on the patio; the latter is moulded into 30 lb. blocks, piled on an iron plate, covered with a large iron bell, and heated by means of a charcoal fire around the bell. The mercury is vaporized, and (the joint at the edge of the bell being carefully luted) passes down through a pipe in the iron plate into a cistern of water. The bell furnace is less economical of fuel and mercury than muffle or retort furnaces; it loses 0·8 per cent. of mercury. The silver, found in solid masses when the bell is raised, is cast into ingots of 80 or 90 lbs. By the patio process the usual product of silver is 50 to 66 per cent. of that contained in the ore; the most docile ores, under favorable circumstances, have yielded 90 per cent. The loss of quicksilver is given by Kerl as 3 to 5 per cent. of the quantity used; earlier accounts make it considerably greater. This loss is due to the formation in the torta of soluble mercury dichloride (calomel), which is afterward washed away.—The *cazo* process, used in Mexico and Chili, is a hot amalgamation in kettles. The ore (in Mexico chloride, in Chili sulphide) is placed, in the form of a watery pulp, in a vat with copper bottom and wooden or stone sides. Here it is heated and stirred with salt and quicksilver, copper vitriol being added in the treatment of sulphides. The process is rapid and effects a tolerably complete extraction of silver, but involves great loss of quicksilver (2 to 2·5 times the weight of silver) when applied to sulphide ore. Silver ores free from sulphides of other metals are amalgamated at Guanajuato, Mexico, in arrastras, by simple grinding and mixing with quicksilver and water.—Pan amalgamation, called the Washoe process, consists in rubbing together in pans (usually of cast iron) the watery mixture of crushed ore (pulp) with quicksilver, with or without the addition of other chemicals. The simplest form of it may be thus described: The ore suitable for this process (usually containing silver sulphide or chloride and native silver, with little antimony, arsenic, base sulphides, in a gangue of quartz) is first crushed in a stamp mill, similar in most respects to that employed for gold-bearing quartz. (See GOLD.) The screens which regulate the size of the crushed particles are of wire cloth with 40 to 60 meshes to the inch, or of Russia sheet iron, perforated with holes $\frac{1}{40}$ to $\frac{1}{24}$ in. in diameter. The pulp reduced to this fineness

is ground and amalgamated in pans, of which there are numerous forms. The charge for a pan is 800 to 1,500 lbs.; the very large pans, treating tailings which have been already ground fine, can take 3,000 to 4,500 lbs. To maintain a proper temperature, steam is introduced into the pulp or into a steam chamber under the bottom, and a wooden cover is usually kept on the pan. The pulp is generally ground for one or two hours; then the quicksilver is sprinkled in (usually 60 to 70 lbs. to a charge of 1,200 or 1,500 lbs.), and, the mullers being raised to avoid too much grinding, which would "flour" the mercury, stirring is continued for two or three hours longer, after which the pulp is diluted and drawn off into a settler. The modification of the Washoe process invented by Mr. Henry Janin, consisting in the use of large quantities of copper vitriol (blue stone) and salt, has proved very successful in the reduction of refractory ores not otherwise amalgamable. The quicksilver, charged with amalgam, is washed, skimmed, and strained through a canvas bag, which retains the amalgam. This is then distilled in cast-iron retorts, the mercury being collected under water, while the "retort bullion" remains behind. About one sixth of the charge retorted, or 200 lbs. of bullion from 1,200 lbs. of amalgam, is usually obtained from the retort, to be broken up, melted, and cast into ingots; it loses 2 to 3 per cent. in melting. The ingots are assayed, and their fineness in thousandths of gold and silver is stamped upon them. The coin value of the Comstock bullion is $1 75 to $2, one third of which is due to the gold it contains. The pulp escaping from the apparatus in which the amalgam is collected is called "tailings." The tailings are often concentrated upon blankets or otherwise, or are simply allowed to settle in reservoirs, for reworking. The "slimes" or "slums" comprise that part of the ore which is crushed under the stamps to an impalpably fine condition, and escapes in the battery water without ever getting into the pans. Since many silver ores yield much fine powder in crushing, the slimes are often far richer than the tailings, the value of the latter being largely in the particles of quicksilver and amalgam which they contain. The chemistry of the Washoe process is summed up by Mr. Arnold Hague as follows: that the ore submitted to it consists chiefly of native gold, native silver, and argentiferous sulphurets, associated with varying proportions of blende and galena; that the action of sodium chloride and copper sulphate in the pan produces copper chloride, while the presence of metallic iron causes the formation of copper dichloride; that both the chlorides of copper assist in the reduction of the ore by chloridizing the sulphurets of silver and decomposing the sulphurets of lead and zinc; that sulphate of copper enhances the amalgamating energy of mercury, by causing the formation of a small quantity of copper amalgam, and also tends to expel the lead; but that the quantities of chemical agents usually added in the Washoe process are too small to be effective, and that the principal agents in the reduction are in general mercury and the iron of the pan, aided by heat and friction. The essential condition in the amalgamation is the keeping of the mercury bright and pure, that it may come into direct contact with the iron and sulphide of silver. The consumption of mercury in the Washoe process may be considered chiefly a mechanical loss, and only to a limited extent a chemical one. The pan amalgamation of slimes and refractory ores, with the addition of large proportions of copper sulphate and salt, involves a greater loss of mercury.—Refractory ores, not suitable for "raw" amalgamation by the Washoe or the patio process, are treated in many localities by the Freiberg process, consisting in the chlorination of the ore by roasting with salt, and its subsequent amalgamation. At Freiberg in Saxony, where this method originated, it has been abandoned, the ores formerly amalgamated being now treated by smelting. But in districts where fuel is scarce and labor dear, and lead ores for smelting are not at hand (which is the case in many parts of Nevada, for instance), the Freiberg system is still successfully employed, though greatly modified as to apparatus. The ore is crushed in stamp mills, without water, and the fine powder is further dried, usually by spreading on the top of the arch or the dust chambers of the roasting furnace. Either in the battery, during crushing, or on the drying or the charging floor, 6 to 7 per cent. (for rich ores, up to 20 per cent.) of salt is mixed with the ore. The mixture is then roasted, to chloridize the silver; this was done abroad in reverberatory furnaces, which have been used in Colorado and Nevada also, but are now generally replaced in the west by Stetefeldt's showering furnace or Brückner's cylinder. From the roasting furnace the ore is conveyed to the pans, where it undergoes an amalgamation similar to that of the simple Washoe process, except that less grinding is necessary. The Freiberg amalgamation was performed in revolving wooden barrels, which are still employed at some places in the United States. Each apparatus has its partisans. A peculiar method of amalgamation pursued in Chili avoids the chloridizing roasting, substituting a humid chlorination by means of copper dichloride (Kröncke's process). It is highly praised, but not yet widely employed. The use for this purpose of copper chloride, which is of earlier origin, involves a loss of quicksilver as calomel.—The processes of humid extraction of silver are of two classes. Either the silver is converted into a soluble compound and separated by leaching and precipitation, or the baser metallic constituents of the ore are rendered soluble and removed by leaching, leaving an auriferous and argentiferous residuum for further treatment. The methods of the first class convert the silver

into chloride or sulphate, the former by a chloridizing, the latter by an oxidizing roasting. The chloridizing roasting is essentially that of the Freiberg amalgamation process, and is effected by mixing salt with the charge. The silver chloride is extracted from the mass by lixiviation with hot brine (old Augustin process), cold brine (Hungarian improvement), sodium hyposulphite (Patera process), or calcium hyposulphite (Kiss process in Hungary and Russia, Hofmann in Mexico). The latter extracts also gold chloride if it is present, which brine will not do, unless it has been, as Patera recommends, impregnated with free chlorine gas. Experiments conducted at Wyandotte, Mich., by Messrs. Courtis and Hahn, indicate the availability of other chlorides than common salt (particularly calcium chloride, or a solution obtained by treating common limestone with muriatic acid) as a solvent for the silver chloride. The novel and important results of these investigations are given in the "Transactions of the American Institute of Mining Engineers." From its hyposulphite or chloride solution the silver is precipitated with metallic copper, as cement silver, which is washed, pressed, melted, and cast into bars. Ziervogel's method of extracting silver by roasting the sulphuretted ore to produce silver sulphate, leaching this with hot acidulated water, and precipitating with copper, is the simplest and cheapest of all; but it requires very skilful and delicate roasting, and ores comparatively free from lead, antimony, arsenic, and zinc. The three latter tend to cause volatilization of silver; the sulphide of antimony and lead cause a sintering of the roasting charge; copper dioxide, or too high a temperature in the furnace, leads to the formation of metallic silver, instead of the desired sulphate. Hence the application of this process is limited. Its best field is the treatment of the copper mattes of Mansfeld, containing 70 to 72 per cent. of copper, and 0·33 per cent. of silver. The so-called acid extraction is principally used upon cupriferous furnace products, which contain too much lead, antimony, arsenic, &c., to permit treatment by the Augustin or the Ziervogel method. In this process, the base metals are dissolved out by treatment with sulphuric or muriatic acid, and the residuum, containing gold and silver, is further reduced by smelting, or in rare instances by humid methods. For full discussions of all the foregoing processes, see Percy's "Metallurgy," and Bruno Kerl's *Metallhüttenkunde.* The details of American practice, and critical comparisons of different American and foreign methods, are given in the reports of R. W. Raymond, United States commissioner of mining statistics, and in the "Transactions of the American Institute of Mining Engineers."—The principal uses of silver have been mentioned already in this article; see also COINS, GALVANISM (section on electrotyping), MINT, and PLATED WARE. The real value of silver as compared to gold has varied in different ages from one eighth to less than one sixteenth; but the mint rates have often been arbitrarily established by government for the profit of the treasury, in spite of the market price of the metals. At present it is lower than at any previous period. The average ratio of value of silver to gold in the London market for the year ending Dec. 31, 1874, was 1 to 16·27. The following table shows the estimated product of silver at various periods in the present century:

| COUNTRIES. | Estimate of J. Arthur Phillips for 1800. | Estimate of Birkmyre for 1846. | Estimate of J. Arthur Phillips for 1850. | Estimate of Birkmyre for 1850. | Estimate of J. D. Whitney for 1854. | Estimate of J. Arthur Phillips for 1865. | Estimate of W. P. Blake for 1867. |
|---|---|---|---|---|---|---|---|
| | Weight, lbs. troy. | Value, £ sterling. | Weight, lbs. troy. | Value, £ sterling. | Value, U. S. coin. | Weight, lbs. troy. | Value, U. S. coin. |
| Russian empire | 58,150 | £167,831 | 60,000 | £171,817 | $928,000 | 58,000 | $700,000 |
| Scandinavia | | 32,346 | 20,400 | 35,607 | 828,000 | 15,000 | |
| Great Britain | | 109,989 | 48,500 | 160,000 | 1,120,000 | 60,500 | |
| Hartz | | 138,022 | 31,500 | 138,022 | 480,000 | 28,000 | |
| Prussia | | | 21,200 | | 480,000 | 68,000 | |
| Saxony | | 198,200 | 63,600 | 198,200 | 960,000 | 80,000 | |
| Other German states | 141,000 | | 2,500 | | 48,000 | 2,500 | 8,600,000 |
| Austria | | 282,654 | 87,000 | 286,971 | 1,440,000 | 92,000 | |
| France | | | 5,000 | | 80,000 | 18,000 | |
| Italy | | 7.444 | | 7,444 | | 25,000 | |
| Spain | | 227,499 | 125,000 | 440,210 | 2,000,000 | 110,000 | |
| Australia | | | | | | | |
| British America | | | 10,000 | | 128,000 | 9,500 | 20,000 |
| Chili | 18,300 | 297,029 | 238,500 | 297,029 | 4,000,000 | 299,000 | |
| Bolivia | 271,800 | 460,191 | 130,000 | 460,191 | 2,080,000 | 136,000 | |
| Peru | 401,850 | 1,000,583 | 803,150 | 1,000,583 | 4,800,000 | 299,000 | 10,000,000 |
| New Granada | 5,000 | 42,929 | 13,000 | 42,929 | 208,000 | 15,000 | |
| Brazil | 1,200 | 2,003 | 675 | 2,227 | 11,200 | 1,500 | |
| Mexico | 1,440,500 | 3,457,020 | 1,650,000 | 5,383,333 | 28,000,000 | 1,700,000 | 19,000,000 |
| United States | | 1,864 | 17,400 | 73,532 | 852,000 | 1,000,000 | 15,500,000 |
| East Indies | | 56,265 | | 56,265 | | | |
| Africa | | 1,056 | | 1,056 | | | |
| Various other countries | | 33,000 | | 33,000 | | | |
| Total | 2,337,300 | £6,515,925 | 2,827,425 | £8,788,416 | $47,443,200 | 4,017,000 | $53,820,000 |
| Approximate value in U. S. coin | $36,250,000 | $31,537,000 | $43,853,000 | $42,536,000 | $47,443,800 | $62,303,000 | $53,820,000 |

The following estimate of the world's product of silver in 1873 is based upon returns for Germany, Austria, France, Great Britain, Spain, and the United States, and for other countries upon the most recent available accounts: Great Britain and colonies, $1,000,000; Sweden and Norway, $250,000; Russia, $500,000; Austro-Hungarian monarchy, $1,600,000; German empire, $3,000,000; France, $2,000,000; Spain, $2,000,000; Italy (Sardinia), $500,000; Mexico, $20,000,000; Central and South America, $8,000,000; Canada, $900,000; United States, $36,500,000; total, $76,250,000. According to Humboldt and Danson, the value of silver produced in Mexico and Peru from 1492 to 1803 was $4,152,650,000. The production in Europe during the same period was about $200,000,000. For the period from 1804 to 1848 Danson gives $1,244,380,794 as the production of Mexico and South America, that of Europe and Asiatic Russia for the same period having been about $325,000,000. For the period from 1848 to 1868, Prof. W. P. Blake, in his "Report on the Production of the Precious Metals," gives the following estimate of the silver product: United States, $73,000,000; Mexico, $380,000,000; South America, $200,000,000; Australia, $20,000; Europe and Asiatic Russia, $160,380,000; total, $813,400,000. From 1868 to 1875 the product of silver may be approximately estimated at $163,000,000 for the United States, $140,000,000 for Mexico, $56,000,000 for South America, and $63,000,000 for the rest of the world. (None of these estimates include the produce of Japan, China, and central Asia, of which nothing is known.) We have then, as the grand total of the silver product from the discovery of America to the present time, $7,150,000,000.—*Mines.* The silver produced in Great Britain is extracted from an argentiferous lead, to the amount of 550,000 to 700,000 oz. annually (in 1872, 628,000 oz.). The celebrated Kongsberg mines in Norway, discovered in 1623, have been worked almost continually since. The ore occurs in parallel belts of rock, intercalated in gneiss and crystalline schists, and impregnated with sulphides of iron, copper, zinc, and sometimes lead, cobalt, and silver. Fissure veins traverse these belts occasionally, and are argentiferous at the intersection only. Beautiful specimens of native silver occur. The total product of the Kongsberg mines from 1624 to 1864 was 1,817,510 lbs. troy of silver, of which 1,332,485 lbs. was produced before 1805 and 463,498 lbs. after 1815, the intervening period being one of discouragement. The yield for the 30 years preceding 1865 averaged $350,000 annually. The silver mines of Sweden are at present insignificant, and the total product in 1871 was officially reported at but 975 kilos. The silver mines of the Austro-Hungarian monarchy are principally comprised in Hungary, Transylvania, and Bohemia. The Schemnitz district in Hungary (the seat of a celebrated school of mines, founded in 1760 by Maria Theresa) is traversed by a group of veins in porphyry, associated with syenite, &c. The ores comprise numerous argentiferous minerals, of which silver glance and galena are the chief. The Schemnitz mines were first opened more than 800 years ago, and have been worked to a depth of more than 1,200 ft. Near Schemnitz are the mining districts of Kremnitz and Neusohl. The Joachimsthal mines in Bohemia are very ancient, very deep (nearly or quite 2,000 ft.), and have been very productive, but now yield an insignificant amount of silver. This district belongs to the Erzgebirge, a chain of mountains composed of crystalline rocks, on the border of Saxony, in which kingdom it includes the four mining districts of Altenberg (tin), Freiberg, Marienberg, and Schwarzenberg. The official statistics of Saxony show that the total product of silver in these districts in 1872 was 48,753 lbs., and in 1873 43,354 lbs. The Freiberg district is by far the most important, containing nearly 100 mines, many of which are more than 1,400 ft. deep, producing almost the whole of the above amounts. Previous to the 10th century it was a wilderness. The lead ores were discovered in the tracks made by wagon wheels, and in 1169 the veins were opened. They are very numerous, but comparatively small. In 1873 only 24 mines were producing silver ore, and of these only 6 paid dividends. The Himmelfahrt, which is now the leading mine, in 1873 yielded 11,912 metric tons of silver, copper, and lead ores, valued at about $430,000. In 1874 it produced about 7,100 tons of dressed ores, sold to the furnaces for about $328,000. The total yield of this mine to the end of 1874 had been 527,103 kilos of silver (worth about $23,000,000), besides lead, copper, zinc, sulphur, arsenic, and nickel. The chief other productive mines near Freiberg, with the value of their total product (including lead, &c.), as paid by the smelting works, for 1873, are as follows: Himmelsfürst, $202,500; Vereinigt Feld, $114,750; Churprinz, $74,000; Alte Hoffnung, $61,000; Gesegnete Bergmannshoffnung, $60,750; Alte Hoffnung Gottes, $52,750; Junge hohe Birke, $45,450; and Beschert Glück, $34,600. The principal silver mines of Prussia are in the Hartz, formerly belonging to Hanover. The product of Prussian smelting works in 1872 was 162,553 lbs. of silver, worth about $3,600,000; in 1873, 231,920 lbs., worth about $5,000,000. The total product of silver from the smelting works of all Germany was as follows in the years named:

| YEARS. | Centner. | Value in round numbers. |
|---|---|---|
| 1850 | 101,448 | $2,234,000 |
| 1860 | 124,103 | 2,764,000 |
| 1870 | 185,847 | 4,162,000 |

A considerable portion of this increase is due to the importation of rich silver ores from

North and South America for metallurgical treatment, and another portion to the improved processes of extraction. The product from German ores is probably not more than $3,000,000. France is not a silver-ore producing country; but the separation of silver from argentiferous lead ores is carried on to a considerable extent. In 1865 it produced 31,997 kilos of silver, worth $1,414,000; in 1869 (the year before the war), 46,299 kilos, worth $2,020,000. No Spanish silver mines were specially important after the middle ages down to 1825, except those of Guadalcanal and Cazalla, N. E. of Seville, which were profitably worked by the government in the 16th century, producing altogether 400,223 marks of silver; afterward they passed into private hands, and in the beginning of the 17th century are said to have produced 170 marks daily. They were finally abandoned, and allowed to fill with water. In 1825 mining was revived in Spain; in 1839 the famous silver mines of the Sierra Almagrera (N. and S. veins in slate, carrying argentiferous galena, with some silver chloride), in the province of Almeria, were discovered, and in 1843 those of Hiendelaencina (narrow E. and W. veins of silver sulphide and chloride, without lead), in the province of Guadalajara. The Herminia mine, in the Sierra Almagrera, in 1874 produced 18,940 quintals of ore, containing 342,325 lbs. of lead and 41,670 Spanish oz. (3,205 lbs. troy) of silver. The product of the mine in the early part of 1875 was at the rate of about 10,000 lbs. troy per annum. The average value of the work lead is about 20 oz. troy per ton avoirdupois. The product of the mines of Hiendelaencina from January, 1847, to July, 1866, was 7,578,536 oz. troy. They have declined in yield since 1858. By the application of the Pattinson process to the argentiferous galenas of the numerous lead mines of Spain, the production of silver has been increased. The export of lead in 1874 was 86,802,271 kilos, valued at 47,034,022 pesetas. This indicates a value of about $1,700,000 for the silver in the lead. The product of Russia in 1871, from 21 mines of argentiferous galena, was 1,740 tons of lead and 29,000 lbs. of silver. —The conquest of Mexico by Cortes in 1519–'21 was soon followed by the development of the wonderfully rich silver mines of that country. The metal was known to the ancient Aztecs, and was worked by them into numerous ornamental and useful articles; but among the treasures of Montezuma the quantity of silver was small compared with that of gold, and gave little promise of the unbounded resources of the argentiferous mines of his territories. During the 16th century these were opened and extensively worked by the Spaniards in Guanajuato, Zacatecas, and other neighboring districts; and in the 17th and 18th centuries their production was greatly increased by reason of the greater abundance of quicksilver and its more general employment in separating the metal from its ores. At the time of the visit of Humboldt operations were carried on in from 4,000 to 5,000 localities, which might all be included in about 3,000 distinct mines. These were scattered along the range of the Cordilleras in eight groups, the principal of which, known as the central group, contained the famous mining districts of Guanajuato, Catorce, Zacatecas, and Sombrerete, and furnished more than half of all the silver produced in Mexico. The mines of Guanajuato, opened in 1558, are all upon the great vein, known as the *veta madre*, in the range of porphyritic hills the summits of which are from 9,000 to 9,500 ft. above the sea, but only about 3,000 ft. above the high plateau of central Mexico upon which they stand. The great vein is contained chiefly in clay slate, and crosses the southern slope of the hills in a N. W. and S. E. direction, dipping with the slates (the range of which it follows) from 45° to 48° toward the S. W. It is of extraordinary thickness, often more than 150 ft. across, and is said to have been traced for about 12 m.; but the productive portions are chiefly upon a length of about 1¼ m. The vein is made up of quartz, carbonate of lime, fragments of clay slate, together with large quantities of iron pyrites, and sulphurets of lead and zinc with some native silver, sulphuret of silver, and red silver. Near the surface they are partially decomposed and colored red, whence they are termed *colorados*. In their unchanged condition below they are designated *negros* or black ores. These are the main dependence of the mines. The vein has been penetrated to the depth of about 2,000 ft., but not much below the level of the plateau. For the two years ending in July, 1873, 115 mines in this district produced 202,125 kilos of silver ($8,045,425), 36 *haciendas* and *zangerros* being employed in reduction. In 1873 the number of miners and laborers was 8,979, and the amount of ore raised was 1,815 tons weekly; average contents of silver, about 34 oz. troy to the ton avoirdupois. The mine of Valenciana, opened in 1760, upon a rich portion of the vein, averaged for many years a product of $1,600,000, or about $\frac{1}{15}$ of the total product of the 3,000 mines of Mexico, and a quarter of that of the whole of the *veta madre*. It declined in productiveness at the beginning of this century, was suspended in 1810 on account of the war of independence, reopened in 1822 by the Anglo-Mexican company, and abandoned after much expenditure to the Mexican owners. It is the deepest mine in the country, and the lower workings are now flooded. In 1873 it employed 1,950 laborers, and yielded about 195 tons of ore weekly. The mines of Zacatecas, opened in 1548, are also upon a single vein called the *veta grande*, averaging in thickness about 30 ft. The formation is of greenstone and clay slate, the former the most productive. The veins of Catorce are in limestone supposed to be of carboniferous age. The

greatest proportion of silver in every mining district of Mexico is obtained from the sulphuret of silver, an ore of gray color disseminated through the quartz matrix in minute particles, and more or less combined with other metals. The other varieties of argentiferous ores are numerous, but comparatively small in quantity; they are the chloride of silver, ruby silver, native silver, argentiferous pyrites, and argentiferous galena. The comparative quantities of these at the different mines are very variable. Until the present century the ores were extracted altogether by the rude methods of the native Indians. They brought them upon their backs up the long flights of thousands of roughly formed steps, in loads of 240 to 380 lbs. each, while exposed all the time to the great heat of the mine. In 1821 the Mexican government offered facilities for foreigners to become interested with the natives in the mines. English mining companies were formed, and operations were undertaken with powerful machinery; but the adventures were almost universally unsuccessful, the nature of the country being extremely unfavorable for the introduction of heavy machines, as well as for keeping them in operation and repair. From the opening of the Mexican mines in the 16th century their production of silver has exceeded that of all other countries. A great stimulus was given to it by the amalgamating process devised by Medina at that early period in Mexico, and it soon attained an annual rate of from $2,000,000 to $3,000,000. This continued to increase till in the 18th century it rose to $23,000,000, which was about the production for the first ten years of the present century. After 1850 it increased, till for some years it exceeded the yield of all past periods. The total product, from the first working of the mines by the Spaniards to their expulsion by the Mexicans in 1821, was $2,368,952,000. A very promising field for silver mining is found in the state of Sinaloa and along the western slope of the Sierra Madre of Durango and Chihuahua. The port of Mazatlan is the base of supplies. Sinaloa is well wooded and watered; the ores are largely true silver ores, which can be treated by the Freiberg or the modified Washoe process. Some of the mines in the interior are exporting rich silver ores to Europe; others are reported to be earning good profits with stamp mills. Central America has no silver mines that are worked to much extent; but rich ores are known to exist in Honduras, Nicaragua, and Costa Rica.—The famous mines of Potosí in Peru (now in Bolivia) were discovered in 1545 by an Indian hunter, Diego Hualca, who, according to Acosta, accidentally exposed native lumps of the precious metal in the roots of a bush which he pulled from the ground. For 20 years succeeding 1557 the annual production of the mines of this region was about $2,200,000, and the total product up to the present time is rated at over $1,300,000,000. The mines, like so many others in Mexico and South America, are now reported to be flooded in their depths. In the Cerro de Fernando at Hualgayoc, near Micuipamba, rich ores were discovered in 1771, and now, it is said, about 1,400 pits are opened in the hill. Other mining districts in Peru are Gualanca in the province of Huamalies, Pasco, Lucanas, and Huantajaya. Cerro de Pasco has been especially famous for its large production. A town is built upon the site of the mines, and the openings to many of them are through the houses of the miners. The production of Peru until within a few years was very small, probably not more than $2,500,000 annually, and it is a very difficult field for mining. Roads, mules, labor, and fuel are all wanting. The ores (except the *pacos* or ferruginous earths of Cerro de Pasco), being complex sulphurets, are exceedingly refractory. In the absence of better fuel, llama dung is employed for roasting at several establishments. But the country is full of undeveloped veins, and coal has been discovered in abundance, while railroads are rapidly extending into the interior. In Bolivia, besides the mines of Potosí, are those of Portugalete in the province of Chichas, celebrated for the richness of their ores, which produce six to eight times as much silver to the ton as those of Potosí. Other mines are worked in the same district. The mines of Lipes have been very productive, and those also of La Plata, Porco, Carangas, and Oruro. The earlier silver mines worked in Chili were in the province of Santiago and in the mineral district of Arqueros, about 17 leagues from Coquimbo. The production was not large, and almost ceased upon the opening of the rich mines near Copiapó in the province of Atacama. Within a circuit of 25 leagues from this city there are 19 silver-mining districts, of which those of Chañarcillo and Tres Puntas are the most important. The metal is found in a variety of combinations, as a sulphuret, chloride, chlorobromide, and iodide; it is also associated with arsenic, antimony, and mercury, and is sometimes abundant in a native state. The mines are in a country difficult of access, quite unproductive even in the timber and fuel required for mining, almost entirely destitute of water, and cold and dreary. A new and rich district has been developed at Caracoles, where the ores, like most of those of Copiapó, are chlorides, and easy to reduce.—Silver mining in the western United States, apart from the early operations of the Spaniards in New Mexico and perhaps Arizona, dates from the discovery in 1859, on the E. flank of the Sierra Nevada, in the present state of Nevada, of the now famous Comstock lode. (See Nevada.) No equally important argentiferous deposit has since been discovered; and, in view of the most recent exposures of vast bodies of ore at great depth on the Comstock, it may be doubted whether its

equal was ever known before. There is no other authentic record of the extraction in a single year of more than $23,000,000 in gold and silver from one vein, which was the product of the Comstock in 1874. And the total estimated product of this lode from 1861 to 1874 inclusive was more than $169,000,000, or about the same as the yield of the score of veins at Potosí for the first 15 years after their discovery in 1545. The bullion from the Comstock lode has averaged about one third gold in value, or say 0·02 in weight. As a consequence of the excitement (almost equal to that attending the discovery of gold in California) which followed the success of the Comstock mines, the districts of Nevada, Idaho, Montana, Arizona, and finally Utah and Colorado, were overrun with prospectors. The mining districts of Owyhee in Idaho, and Unionville, Reese River, Belmont, Pioche, White Pine, and Eureka in Nevada, have been the scenes of successive excitements, and are still productive. In Eureka district, as in the principal districts of Utah, and some of those in Montana, Colorado, New Mexico, and California, argentiferous cerussite and galena are smelted, to produce work lead containing silver. This industry has suddenly grown to large dimensions in the west, as may be seen from the following table of the product of work lead:

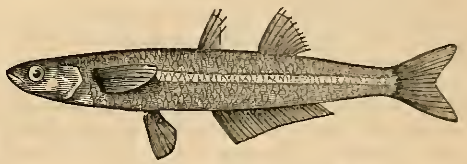
| WHERE PRODUCED. | 1873. Tons. | Gold, silver, and lead, value. | 1874. Tons. | Gold, silver, and lead, value. |
|---|---|---|---|---|
| Nevada........... | 12,812 | $5,043,235 | 11,516 | $3,865,419 |
| Utah............... | 9,566 | 2,901,191 | 15,474 | 4,332,720 |
| California......... | 4,000 | 920,000 | 5,095 | 1,680,000 |
| Montana, Colorado, &c. (estimated).. | 300 | 144,000 | 375 | 180,000 |
| Total........... | 26,678 | $9,008,426 | 32,460 | $10,058,139 |

The Washoe (Comstock) ores and those of Pioche and Owyhee, as well as of many minor districts, are treated by the Washoe process; those of Reese river, Belmont, and Unionville, in Nevada, and of Georgetown, Colorado, receive a preliminary chlorinating roasting. From Colorado and Utah considerable quantities of rich ore are shipped to American and foreign smelting works. Silver mining in Arizona, near the Gila vein, has been rendered unprofitable hitherto by Indian warfare, now apparently ended. The total product of the United States since 1848 is estimated by R. W. Raymond, commissioner of mining statistics, as follows:

| | | | |
|---|---|---|---|
| 1848–1858, inclusive, $50,000 per ann., | $550,000 | 1867............. | $13,500,000 |
| 1859............... | 100,000 | 1868............. | 12,000,000 |
| 1860............... | 150,000 | 1869............. | 13,000,000 |
| 1861............... | 2,000,000 | 1870............. | 16,000,000 |
| 1862............... | 4,500,000 | 1871............. | 22,000,000 |
| 1863............... | 8,500,000 | 1872............. | 25,750,000 |
| 1864............... | 11,000,000 | 1873............. | 36,500,000 |
| 1865............... | 11,250,000 | 1874............. | 38,200,000 |
| 1866............... | 10,000,000 | Total.... ...... | $225,000,000 |

The Atlantic and Mississippi states produce little silver. The amount found with the native copper of Lake Superior is not considerable; but over $2,000,000 has been obtained at the smelting works in Wyandotte, Mich., from the ores of the Silver Islet mine, on the island of that name, on the N. side of Lake Superior. The galena of the Mississippi valley is usually poor in silver, and that of the Atlantic slope is but moderately argentiferous, with an occasional exception, as in the recently discovered deposits near Newburyport, Mass.

**SILVERSIDE, or Silver Fish,** the common name of the small marine spiny-rayed fishes of the family *atherinidæ*, characterized by a protractile mouth, without notch in upper jaw or tubercle in lower, small crowded teeth on the pharyngeals, the first branchial arch with long pectinations, two dorsals most commonly distant, and ventrals behind pectorals; the eyes are very large. In the genus *atherina* (Linn.) the body is elongated, and a broad silvery band runs along each side. The dotted silverside (*A. notata*, Mitch.) is from 3 to 5 in. long, greenish brown with black points on the edges of the scales, and the fins translucent; the dorsals are contiguous, the second reaching as far back as the anal; it is found from New England to South Carolina. It accompanies the smelt in spring and autumn into our riv-



Dotted Silverside (Atherina notata).

ers, and is popularly called capelin. Several other species, about 4 in. long, are found in the southern states and West Indies. More than 20 are described by Cuvier and Valenciennes in vol. x. of the *Histoire naturelle des poissons* (1835); they are much valued as food; they swim in shoals, and are easily taken in nets; the flesh resembles that of the smelt, whence the *A. presbyter* (Cuv.) is often called sand smelt; many species, salted, are sold as sardines, and some are called anchovy.

**SIMART, Pierre Charles.** See p. 879.

**SIMBIRSK. I.** An E. government of European Russia, bordering on Kazan, Samara, Saratov, Penza, and Nizhegorod; area, 19,108 sq. m.; pop. in 1870, 1,205,881. The surface consists generally of a plain, with hills toward the east. The government is drained in the east by the Volga, and in the west by its tributary the Sura. Gypsum, alabaster, limestone, sulphur, and naphtha are found. The soil is fertile, producing grain, hemp, flax, hay, and tobacco. Leather, woollen and linen cloth, tallow, potash, and glass are manufactured. The inhabitants belong chiefly to the Greek church, but there are a few other Christians, and a large number of Mohammedans. **II.** A city, the capital of the government, on the

right bank of the Volga, 105 m. S. S. W. of Kazan, and 435 m. E. S. E. of Moscow; pop. in 1867, 24,607. It stands in the midst of a wide and fertile plain, and contains 16 churches, two convents, and a monument to the historian Karamsin. It has manufactories of soap and candles, and an important trade in grain and fish.

**SIMCOE, Lake.** See ONTARIO, vol. xii., p. 635.

**SIMCOE**, a W. county of Ontario, Canada, bounded N. E. by the Severn river, N. W. by Georgian bay, and S. E. by Lake Simcoe; area, 1,846 sq. m.; pop. in 1871, 64,247, of whom 31,642 were of Irish, 15,020 of English, 11,585 of Scotch, 3,031 of French, and 1,754 of German origin or descent. It is traversed by the Northern railway. Capital, Barrie.

**SIMEON**, the second son of Jacob and Leah. He and his brother Levi were guilty of gross deception and ferocity in their murder of the Shechemites, for which they received their father's curse. Simeon's inheritance as a tribe was not a compact territory, but a small district within the limits of that of Judah, and some tracts in Mount Seir and the district of Gedor. The descendants of Simeon amounted at the exodus to 59,300; but only 22,200 entered the promised land.

**SIMEON, Charles**, an English clergyman, born in Reading, Sept. 24, 1759, died Nov. 13, 1836. He was educated at King's college, Cambridge, and was presented in 1783 to the living of Trinity church, Cambridge, which he held till his death, and was eminently distinguished for devotion to pastoral duty. He published several series of skeleton sermons, forming a commentary upon the whole Bible. They were edited, with his other works, by the Rev. T. H. Horne (21 vols., 1832–'3, and many later editions), and his life has been written by the Rev. William Carus (1847).

**SIMEON STYLITES.** See STYLITES.

**SIMFEROPOL**, or SIMPHEROPOL (Turk. *Akmetchet*), a town of European Russia, capital of the government of Taurida, in the Crimea, on the Salghir, 192 m. S. E. of Odessa, and 37 m. N. E. of Sebastopol; pop. in 1867, 17,797. It stands on a plateau at the foot of lofty hills. The old part of the town, built by the Tartars, is very irregularly laid out, and has a miserable appearance; the new, built by the Russians, has wide straight streets and a spacious square.

**SIMLA**, a town and the summer capital of British India, in a Himalayan district of the same name belonging to the Ambala division of the Punjaub, 170 m. N. of Delhi; lat. 31° 7′ N., lon. 77° 8′ E.; pop. in the height of the season, about 15,000 natives and 1,500 Europeans. It stands on a long and lofty ridge 7,000 ft. above the sea, amid grand forest and mountain scenery, a few miles S. of the Sutlej. The British government purchased the station from the native state of Koonthal about 1822, and founded Simla as a sanitarium. The climate is for the most part cool, exhilarating, and healthful, though there is a heavy rainfall at the time of the S. W. monsoon, and the difficulties of drainage are considerable. Since 1866 the supreme government of India has been administered during the summer months from Simla, whither the viceroy and all the chief officials retire from Calcutta early in the hot season. It is about 60 m. N. E. of the Punjaub and Delhi railway. The town is an organized municipality.

**SIMMONS, Franklin.** See p. 879.

**SIMMS, William Gilmore**, an American author, born in Charleston, S. C., April 17, 1806, died there, June 11, 1870. For some years he was a clerk in a drug store, but at 18 he began the study of law, and in 1827 was admitted to the bar. From 1828 to 1832 he was editor and part proprietor of the "Charleston City Gazette," in which he opposed nullification, thereby reducing himself to poverty. He then devoted himself entirely to literature, living for a time at Hingham, Mass., and afterward principally on a plantation at Midway, S. C., and occasionally holding public offices. His poetical works are: a "Monody on the Death of Charles Cotesworth Pinckney" (1825); "Lyrical and other Poems" and "Early Lays" (1827); "The Vision of Cortes, Cain, and other Poems" (1829); "The Tricolor, or Three Days of Blood in Paris" (1830); "Atalantis, a Story of the Sea" (1833); "Southern Passages and Pictures" (1839); "Donna Anna" (1843); "Grouped Thoughts and Scattered Fancies" (1845); "Lays of the Palmetto" (1848); "Poems, Descriptive, Dramatic, Legendary, and Contemplative" (2 vols., 1854); and "Areytos, or Songs and Ballads of the South" (1860). A collective edition appeared in 1864. He also edited a volume of "War Poetry of the South" (1867). He produced two dramas, "Norman Maurice, or the Man of the People," and "Michael Bonham, or the Fall of Alamo," and adapted Shakespeare's "Timon of Athens" for the stage, with numerous additions of his own. His works of imaginative fiction comprise "The Book of my Lady" (1833); "Carl Werner" (1838); "Confession, or the Blind Heart" (1842); "Castle Dismal" (1845); "The Wigwam and the Cabin" (1845–'6); "Marie de Bernier" (1853); and "Ghost of my Husband" (18mo, 1867). His historical romances are: "The Yemassee" (1835); "Pelayo" (1838); "Count Julian" (1845); "The Damsel of Darien" (1845); "The Lily and the Totem, or the Huguenots in Florida;" "The Maroon and other Tales" (1855); "Vasconcelos" (1857); "The Cazique of Kiawah" (1860); and "Swamp Robbers" (1870). The following are founded on revolutionary events: "The Partisan" (1835); "Mellichampe" (1836); "The Scout," originally published as "The Kinsmen, or the Black Riders of the Congaree" (1841); "Katharine Walton" (1851); "Woodcraft," originally entitled "The Sword and the Distaff;" "The Forayers, a Raid of the Dog Days" (1855), and its sequel "Eutaw" (1856).

Romances of backwoods life: "Guy Rivers" (1834); "Richard Hurdis" (1838); "Border Beagles" (1840); "Beauchampe, or the Kentucky Tragedy" (1842); "Helen Halsey" (1845); "The Golden Christmas, a Chronicle of St. John's, Berkeley" (1852); and "Charlemont, or the Pride of the Village" (1856). A selected edition of his novels appeared in 1865 (17 vols., New York). To history and biography he contributed a "History of South Carolina," "South Carolina in the Revolution" (1854), and lives of Gen. Marion, Capt. John Smith, the chevalier Bayard, and Gen. Greene. Under this head may also be included a "Geography of South Carolina." His remaining works include "Views and Reviews in American Literature;" "Egeria, or Voices of Thought and Counsel for the Woods and Wayside," a collection of aphorisms in prose and verse; "Father Abbot, or the Home Tourist, a Medley;" "Southward Ho!" (1854); "The Morals of Slavery," &c. He also edited with notes the seven dramas ascribed to Shakespeare, but not published among his works, under the title of "A Supplement to Shakespeare's Plays."

**SIMON, Jules** (JULES FRANÇOIS SUISSE-SIMON), a French statesman, born in Lorient, Dec. 31, 1814. After teaching in various places, he lectured in 1838 at the normal school in Paris. In 1839 he succeeded Victor Cousin as professor of philosophy at the Sorbonne, from which post he was removed in 1851 on account of his opposition to the *coup d'état.* In 1848 he entered the constituent assembly, which early in 1849 elected him to the council of state; but not being confirmed by the legislative assembly, he retired in 1850. In 1855 and subsequently he lectured in Belgium on philosophy. He was elected to the legislative body in 1863, and reëlected in 1869 in two departments. He advocated popular education, free trade, the abolition of capital punishment, and the interests of the working classes; and in 1870 he opposed the plebiscitum in favor of Louis Napoleon and the declaration of war against Prussia. After the establishment of the republic (Sept. 4), he became a member of the government for the national defence, as minister of education, religion, and fine arts, and instituted many reforms, the most prominent of which was the obligatory school law. After the capitulation of Paris he went to Bordeaux to put an end to Gambetta's arbitrary proceedings. On Feb. 19, 1871, he became minister of education aud religion under Thiers, with whom he retired, May 24, 1873. He retained his seat in the national assembly, and in 1875 received from the government a pension of 6,000 francs. His works include *Histoire de l'école d'Alexandrie* (2 vols., 1844–'5); *Le devoir* (1854; 6th ed., 1859); *La religion naturelle* (1856; 5th ed., 1859; English translation by I. W. Cole, London, 1857); *La liberté de conscience* (3d ed., 1859); *La liberté* (2 vols., 1859); *L'École* (1864); *Le travail* (1866); *La politique radicale* (1868); *Le libre-échange* (1870); and *Souvenirs du 4 Septembre* (1874; new ed., 1875).

**SIMON, Richard,** a French Biblical critic, born in Dieppe, May 13, 1638, died there, April 11, 1712. He entered the congregation of the Oratory in 1662, was professor of philosophy successively in the college of Juilly and in that of the Oratory in Paris, and in 1671 became involved in a controversy with the Port Royalists by a publication entitled *Fides Ecclesiæ Orientalis.* In 1678 appeared his *Histoire critique du Vieux Testament,* in which he attributes the authorship of the Pentateuch to scribes of the time of Ezra. It was violently assailed by Bossuet and suppressed, and the author excluded from the Oratory. The opinions of Simon have since been adopted by many rationalistic theologians. Among his other works are: *Histoire critique de la créance et des coutumes des nations du Levant* (Amsterdam, 1684); *Histoire critique du texte du Nouveau Testament* (Rotterdam, 1689); *Histoires critiques des principaux commentateurs du Nouveau Testament* (Rotterdam, 1692); and *Nouvelles observations sur le texte et les versions du Nouveau Testament* (Paris, 1695).

**SIMONE DI MARTINO.** See MEMMI.

**SIMONIDES,** a Greek lyric poet, born at Iulis, in the island of Ceos, about 556 B. C., died in Syracuse about 467. His family is said to have held some hereditary office in connection with the worship of Bacchus. After reaching manhood he was invited by Hipparchus to Athens, where, with an interval of a few years, he lived until his 80th year, when he was crowned for his victory in the dithyrambic chorus. His elegies on those who fell at Marathon and Platæa, his epigram on the tombs of the Spartans slain at Thermopylæ, and his odes on the sea fights at Artemisium and Salamis, were celebrated. His latter years were passed in Sicily, at the court of Hiero of Syracuse. He is reproached by Pindar with avarice, having been the first poet on record who wrote for money. He was the most prolific and probably the most popular lyric poet that Greece ever produced. A few fragments are all that remain of his writings, the "Lament of Danaë" being the most celebrated. The best edition is that of Schneidewin, *Simonidis Cei Carminum Reliquiæ* (8vo, Brunswick, 1835).—A writer considered by some his grandson, and known as SIMONIDES THE YOUNGER, was the author of a genealogical work in three books, and of a treatise "On Inventions."—A few fragments remain, including a satire on women, of SIMONIDES THE ELDER, of Amorgos, who flourished about 650 B. C.

**SIMONIN, Louis Laurent,** a French author, born in Marseilles in 1830. He completed his studies at the mining school of St. Étienne, and was employed by the government in mineralogical explorations in the island of Réunion and in Madagascar. He has several times visited the United States, sketches of which he has writ-

ten for the *Revue des Deux Mondes*, and has been since 1865 professor of geology at the central school of architecture. Among his works are: *La richesse minérale de la France* (1865); *L'Étrurie et les Étrusques* (1866); *La vie souterraine* (1867); and *L'Histoire de la terre* (1867).

**SIMON MAGUS**, a magician of the time of the apostles, who by his skill had attained such influence as to be called "the great power of God." While Philip the Evangelist preached in Samaria, in A. D. 36, Simon's followers were converted, and he himself believed and was baptized. Soon after, when Peter and John came to Samaria, to impart to the new converts by means of prayer and the imposition of hands the gifts of the Spirit, Simon, seeing that through the laying on of hands the Holy Ghost was given, offered money to the apostles to impart to him this power. He was sternly rebuked by Peter, and appears no longer in connection with the rising Christian church. The statements of the ecclesiastical writers respecting his further life are contradictory; but it seems certain that he travelled through many countries to give exhibitions of his magic power, and that finally he settled at Rome, where, according to the testimony of Eusebius (with which a statement of Suetonius agrees), he met his death in an aëronautic attempt. About the middle of the 2d century his followers were still very numerous, and Eusebius in the 4th century represents the Simonians as a powerful sect. They early split into several parties, of which the Menandrians and the Dositheans were the most important. (See DOSITHEANS.) Simon wrote several works, the remaining fragments of which are contained in Grabe's *Spicilegium*, vol. i.

**SIMONOSEKI.** See SHIMONOSEKI.

**SIMOOM** (Arabic, from *samma*, to poison), or **Samiel** (Turkish, *sam*, poison, and *yel*, wind), a hot, dry wind common in Syria, Arabia, and India. It comes from the deserts, and is characterized by its excessive heat and suffocating effects, which are sometimes fatal to animal life. It never lasts over an hour, though it sometimes returns for several successive days. During its prevalence the inhabitants of towns and villages shut themselves up in their houses, and those in the deserts in their tents or in pits. The parching heat is derived from the sands, which are whirled up from the earth by the advancing wind, and the whole air is filled with an extremely subtle and penetrating dust. When the wind blows in squalls, death is often very suddenly produced by actual suffocation, and is followed by hæmorrhage at the nose and mouth. Persons exposed to it protect themselves by stopping the mouth and nose with handkerchiefs, and the camels instinctively bury their noses in the sand. The *khamsin* of Egypt and the *harmattan* of Guinea and Senegambia are winds similar to the simoom in their effects, but are of longer duration and more regular in the periods of their prevalence. In India the simoom of the deserts of Cutchee and Upper Sinde is sudden and mysterious in its appearance, invisible and singularly fatal. It usually occurs in June and July, by night as well as by day, sometimes preceded by a cold current of air. Its course is straight and well defined on a narrow path. It is not accompanied by dust, thunder, or lightning, but has a decided sulphurous odor.

**SIMPLON.** See ALPS, vol. i., p. 354.

**SIMPSON.** I. A S. county of Mississippi, bounded W. by Pearl river, and intersected by Strong river; area, about 625 sq. m.; pop. in 1870, 5,718, of whom 1,711 were colored. The soil is sandy, and there are extensive pine woods. The chief productions in 1870 were 72,832 bushels of Indian corn, 15,420 of oats, 29,520 of sweet potatoes, 2,134 bales of cotton, 8,240 lbs. of rice, 5,797 of wool, and 28,860 of butter. There were 871 horses, 1,631 milch cows, 1,237 working oxen, 2,713 other cattle, 4,211 sheep, and 7,793 swine. Capital, Westville. II. A S. county of Kentucky, bordering on Tennessee and drained by tributaries of Big Barren river and by Red river; area, 375 sq. m.; pop. in 1870, 9,573, of whom 2,167 were colored. The surface is level and the soil very fertile. The chief productions in 1870 were 107,242 bushels of wheat, 402,379 of Indian corn, 73,682 of oats, 1,072,401 lbs. of tobacco, 14,572 of wool, 72,004 of butter, and 8,806 gallons of sorghum molasses. There were 2,091 horses, 1,311 milch cows, 1,928 other cattle, 7,410 sheep, and 13,951 swine. The Louisville, Nashville, and Great Southern railroad passes through the capital, Franklin.

**SIMPSON, Sir James Young**, a Scottish physician, born at Bathgate, Linlithgowshire, June 7, 1811, died in Edinburgh, May 6, 1870. He was educated at the university of Edinburgh, where in 1832 he received his degree of M. D. In 1836, as assistant to Prof. Thomson, he delivered a course of pathological lectures; and in 1840 he was elected professor of midwifery in the university of Edinburgh. He was the first to apply the new discovery of anæsthesia to midwifery practice, which he did Jan. 19, 1847. He subsequently discovered the anæsthetical properties of chloroform, which in midwifery practice he regarded as more manageable and powerful, more agreeable to inhale, and less exciting than ether, and as giving greater control over the superinduction of the anæsthetic state. (See ANÆSTHETICS, and CHLOROFORM.) In 1849 he was elected president of the Edinburgh royal college of physicians, in 1852 president of the medico-chirurgical society, and in 1853 foreign associate of the French academy of medicine; and in 1856 he received from the French academy of sciences the Montyon prize of 2,000 francs "in consideration of his services to humanity by the introduction of anæsthesia into the practice of midwifery, and the discovery of the anæsthetic properties of chloroform." He

was very celebrated as a practitioner. Among his works are: "Homœopathy" (3d ed., Edinburgh, 1853; Philadelphia, 1854); "Obstetric Memoirs and Contributions," including his writings on anæsthesia (2 vols., Edinburgh and Philadelphia, 1855–'6); "Acupressure" (1864); and essays on ancient rock sculpturings in Great Britain and other archæological subjects. In 1871 appeared new editions and collections of his writings under the titles "Selected Obstetrical Works," "Anæsthesia and Hospitalism," and "Clinical Lectures on the Diseases of Women;" and in 1872, "Archæological Essays." He was created a baronet in 1866.—See "Memoir," by J. Duns, D. D. (Edinburgh, 1873).

**SIMPSON, Mathew,** an American clergyman, born in Ohio, June 10, 1810. He graduated at Alleghany college, Meadville, Pa., in 1832, and received the degree of M. D. in 1833, but in the same year entered the ministry of the Methodist Episcopal church. In 1837 he was elected professor of natural sciences in Alleghany college, and two years later president of Indiana Asbury university, at Greencastle, Ind. In 1848 he was appointed editor of the "Western Christian Advocate," Cincinnati, and in 1852 was elected bishop. He has been especially active in the promotion of educational and missionary enterprises. During the civil war he was employed on important commissions, and delivered many addresses in support of the Union. In 1863–'4 he made an extended tour, studying the missionary status and wants of his church in Syria, European Turkey, Switzerland, Germany, and Scandinavia. He has been three times a member of general conference, and a fraternal delegate to the British Wesleyan conference and to various ecclesiastical bodies. In 1875 he was appointed to visit again the mission conferences in Europe. His present residence (1876) is Philadelphia.

**SIMPSON, Thomas,** an English mathematician, born in Market-Bosworth, Leicestershire, Aug. 20, 1710, died there, May 14, 1761. He was a weaver, and while young married a widow 50 years of age, having two children, both older than himself; but the family lived in harmony, and Simpson employed his evenings in study, especially of mathematics, and in keeping a school. In 1733 he went to Derby, and in 1735 or 1736 to London, where he soon established himself as a teacher of mathematics, while employing his leisure hours in researches into the higher branches of science. In 1743 he was appointed professor of mathematics in the royal military academy at Woolwich, a post which he filled until the beginning of 1761, when with impaired mental faculties and disordered health he retired to his native town. In 1746 he was elected a fellow of the royal society. He published works on fluxions, the laws of chance, annuities and reversions, algebra, geometry, trigonometry, logarithms, &c.; but his most valuable publication was a volume of "Miscellaneous Tracts" (1754), consisting of four papers on pure mathematics and four on physical astronomy.

**SIMROCK, Karl,** a German author, born in Bonn, Aug. 28, 1802, died July 18, 1876. He studied law at Bonn and Berlin, and was employed in the judicial service from 1823 to 1830, when he was removed on account of his poem on the July revolution in France. In 1850 he was appointed professor of ancient German literature at Bonn. He became famous by his translations of the *Nibelungenlied* (1827; 32d ed., 1876) and many other early German and Scandinavian poems, including the Edda (1851; 4th ed., 1871), and a modernized German version of Hartmann von der Aue's *Der arme Heinrich* (2d enlarged ed., 1875). One of his most celebrated original poems is *Wieland der Schmied* (1835; 3d ed., 1851). In 1867 appeared his translation of Shakespeare's poems, and among his other works are: *Die Quellen des Shakespeare in Novellen, Märchen und Sagen* (1831; new ed., 1872); *Das malerische und romantische Rheinland* (4th ed., 1865); *Handbuch der deutschen Mythologie* (new ed., 1869); and *Faust* (new ed., 1873).

**SIMS, James Marion,** an American surgeon, born in Lancaster district, S. C., Jan. 25, 1813. He graduated at the South Carolina college in 1832, and studied medicine in Charleston and at the Jefferson medical college, Philadelphia. In 1836 he settled at Montgomery, Ala., and soon became widely known as a skilful operator in general surgery. About 1845 his attention was directed to the treatment of vesico-vaginal fistula, hitherto deemed incurable, and he established for the diseases peculiar to women a private hospital, which he supported for four years at his own expense. A protracted series of experiments were crowned with success by the substitution of sutures of silver wire for silken and other sutures, and he afterward extended the use of metallic sutures into every department of general surgery. In 1853 he removed to New York, where through his efforts a temporary and afterward a permanent woman's hospital was established under his charge. In 1861 and 1864 Dr. Sims visited Europe, and in 1870 he organized in Paris the Anglo-American ambulance corps. He has published "Silver Sutures in Surgery" (8vo, New York, 1858) and "Clinical Notes on Uterine Surgery" (London and New York, 1866; translated into French and German).

**SINAI,** a group of mountains in Arabia Petræa, in the southern portion of the peninsula of the same name, which projects between the two forks of the Red sea, the gulf of Suez separating it from Egypt on the west, and the gulf of Akabah from Arabia on the east. The peninsula of Sinai is triangular, about 140 m. in length from N. to S., and nearly the same in breadth at its widest portion. The northern portion is an arid and desert plain, with sand hills and mountains of small elevation; S. of

lat. 29° 20′ N. it rises into several ranges of mountains. There are numerous peaks, varying from 1,000 to over 9,000 ft. above the sea, divided by deep wadys or narrow sand valleys, except in the case of the Wady er-Rahah and the Wady esh-Sheikh, two wide valleys, the former separating the Jebel Ghubsheh from the Jebel el-Fureiah, the latter the Jebel ed-Deir from the same mountain summit, and the two uniting in a wide plain in front of the Ras Sufsafeh, the abrupt northern termination of the Jebel Musa or Mount of Moses, the traditional Sinai. The summits of most historic and Biblical interest, beginning at the S. point of the peninsula, are the Jebel et-Turfa, a long low mountain sloping on either side to the sea and terminating in the low promontory of Ras Mohammed; the Jebel et-Tur, a series of summits of somewhat greater height surrounding the Jebel Musa, and separated from it by narrow steep wadys; the Jebel Katherin or Catarina, S. S. W. of the Jebel Musa, and forming the termination of the range known as the Jebel Humr; and the Jebel Musa, an isolated summit, with a plateau about 3½ m. long and nearly 1 m. in width, gradually descending toward the north. The S. point, from which until recently it was supposed that Israel received the law, is 9,274 ft. high, but is still overlooked by the higher peaks of Jebel Katherin and the Tinieh ridges, and the wadys in front of it are so narrow that the immense congregation could not have seen the summit of the mountain. To avoid this difficulty, Burckhardt, and after him Lepsius and some others, have attempted to demonstrate that the Jebel Serbal, which was sometimes called "the mount of God," lying some distance W. of the Jebel Musa, and having a valley of considerable extent, the Wady Feiran, at its N. face, is the true Sinai, with which Horeb, the Scriptural "mount of God," is so closely connected as to appear identical. But it seems that tradition rather points to that mountain as the site of Rephidim. The N. extremity of the Jebel Musa, called by the monks Horeb, and at its highest point Ras Sufsafeh, or "the mountain of the Willow," is supposed by Robinson and others to be the Sinai from which the law was dispensed. It is divided from the Jebel ed-Deir on the east by a narrow valley, on one of the slopes of which the convent of St. Catharine is situated; but from the termination of the Ras Sufsafeh there open out the two wide valleys already mentioned, the Wady er-Rahah and the Wady esh-Sheikh, the only ones in the Sinaitic peninsula capable of containing the vast host of Israel. Opposite, in a succession of terraces, rises the Jebel Sona, the termination of the Fureiah ridge. The Ras Sufsafeh is 6,541 ft. high, and about 800 ft. lower than Jebel Musa, but it is the commanding point of the amphitheatre upon which it opens. There are three churches and three chapels on this mountain, all small and in a ruinous condition; and on the W. side, 2,000 ft below the summit, is the monastery, celebrated alike for its antiquity, its manuscript treasures, and the hospitality of its monks. The Arabs point out in the Wady er-Rahah the "hill of Aaron," the "pit of Korah," and the place where the molten calf was made. Carl Ritter suggested that Serbal was known before the giving of the law as "the mount of God," and that Pharaoh probably understood it as the mount to which they were going to sacrifice. Its distance and location well agree with this theory, for which early traditions give much ground. Dr. Beke supposed the ancient Mt. Sinai to be a mountain E. of the meridian of the gulf of Akabah and valley of the Jordan. He was sent in 1874 on an expedition to establish his hypothesis. Advancing N. from the town of Akabah, by the route E. of the Jebel esh-Sherah, through the Wady el-Ithm, he found what answered his expectations in Mt. Baghir, also called Jebel en-Nur, or "mountain of Light." He bases his identification on an argument that, according to Scripture, the land of Midian, to which Moses fled, formed part of the east country, *i. e.*, E. of the Jordan, and that he conducted the children of Israel there; and hence it follows that he crossed with them the gulf of Akabah, and not the present gulf of Suez. Dr. Brugsch also has recently advanced a theory which takes the Scriptural Mt. Sinai out of the so-called Sinaitic peninsula. He is of opinion that the Israelites marched along the Mediterranean coast, and that the disaster of the Egyptians occurred on the narrow strip of land which separates the sea from the Serbonian lake. There are many difficulties in the way of harmonizing these views with the details of the Biblical narrative. As to Horeb in Scriptures, it seems probable that the whole desert of Sinai was so called (Heb. *'hareb*, parched), and that the name was also specially applied to Sinai itself. From a period certainly not later than the first half of the 3d century, the caves of Jebel Musa, the traditional Mt. Sinai, were a refuge of persecuted Christians; in the 4th century they were the resort of anchorites and ascetics, and these were repeatedly attacked and murdered by the Arabs. In the 5th and 6th centuries the monks of Mt. Sinai were represented in the great councils of the eastern church. During the period in which the Mohammedan power was at its height, the monks lived in fear and disquiet, often threatened and occasionally attacked. From the crusades onward they have held more peaceful possession, but with greatly diminished numbers and influence.—See Robinson, "Biblical Researches" (3 vols., Boston, 1856); Stanley, "Sinai and Palestine" (London, 1858); Wilson and Palmer, "Ordnance Survey of the Peninsula of Sinai" (London, 1872); Palmer, "The Desert of the Exodus" (London and New York, 1872); Ebers, *Durch Gosen zum Sinai* (Leipsic, 1872); and Maughan, "The Alps of Arabia" (London, 1874).

**SINALOA.** **I.** A N. W. state of Mexico, bounded N. by Sonora, E. by Chihuahua and Durango, S. by Jalisco, and W. by the Pacific and the gulf of California; area, 25,927 sq. m.; pop. in 1869, 163,095. The entire eastern portion is mountainous, being traversed by a branch of the Sierra Madre; while the western comprises extensive plains gradually declining toward the coast, which is generally low. The coast is indented by bays, the largest of which is that of Navachiste, and presents several harbors, such as Mazatlan, Angeles, Altata, Tamazulla, Popolobampo, and Navachiste, none of which are very commodious. The chief rivers are the Fuerte and Cañas, forming respectively the northern and southern boundaries, Sinaloa, and Culiacan; some of these, with their affluents, periodically overflow their banks, fertilizing the surrounding country. The mineral productions include gold, silver, platinum, copper, iron, lead, and sulphur; but mines of the first two only are worked, the average annual yield being $500,000, of which seven eighths is silver. The climate is excessively hot, and in many parts unhealthful, particularly in the south and in the coast region. The soil is for the most part fertile; the principal agricultural products are coffee, rice, and sugar cane. Many of the tropical fruits, particularly guavas and bananas, are very abundant, though the last are so extensively consumed as to be imported in immense quantities. The chief occupations are agriculture and mining, the manufacture of castor oil and the liquor called *mezcal*, and pearl and tortoise fisheries along the coasts. Brazil wood, pearls, gold, and silver are exported in large quantities. Sinaloa is divided into the districts of Rosario, Concordia, Mazatlan, San Ignacio, Cosalá, Culiacan, Mocorito, Sinaloa and Fuerte. The capital is Culiacan, and the chief port Mazatlan. **II.** An inland town of the preceding state, on the right bank of a river of the same name, in the midst of a gold-mining district, 220 m. N. N. W. of Mazatlan; pop. about 9,000. It has good houses, a church, and a school; and the inhabitants are chiefly engaged in mining. It was the capital of the old province of Sinaloa.

**SINCLAIR.** **I.** Sir **John,** a Scottish agriculturist, born at Thurso castle, Caithness, May 10, 1754, died Dec. 21, 1835. From 1780 to 1810 he was a member of parliament. He had an estate of 100,000 acres in Caithness, and devoted himself to the development of agriculture, the improvement of wool, and the revival of coast fisheries; and he built up the village of Thurso into a flourishing port. In 1786 he was created a baronet. The board of agriculture was established by act of parliament in 1793 mainly through his efforts, and he was its first president. He was the author of numerous volumes and pamphlets on agriculture, finances, and other subjects, and also published "Observations on the Scottish Dialect" (1782); "History of the Public Revenue of the British Empire" (3 vols., 1785-'9); "Statistical Account of Scotland" (21 vols., 1791-'9); and "Code of Health and Longevity" (4 vols., 1807). **II.** Sir **George,** a Scottish author, son of the preceding, born in Edinburgh, Oct. 23, 1790, died Oct. 9, 1868. For several years he represented Caithness in parliament. He published "Selections from the Correspondence on the Scottish Church Question" (1842); "Letters to the Protestants of Scotland" (1852); "Miscellaneous Thoughts on Popery, Prelacy, and Presbyterianism" (1853); "Two Hundred Years of Popery in France, 1515-1715" (1853); and "Popery in the First Century" (1855). His life has been written by James Grant (London, 1869). **III. John,** a Scottish clergyman, brother of the preceding, born Aug. 20, 1797, died in London, May 22, 1875. After graduating at Pembroke college, Oxford, he took orders, and in 1843 was made archdeacon of Middlesex. In 1853 he visited the United States in behalf of the society for the propagation of the gospel. He published a life of his father (2 vols., Edinburgh, 1837), and "Sketches of Old Times and Distant Places" (London, 1875). **IV. Catharine,** a Scottish authoress, sister of the preceding, born in Edinburgh, April 17, 1800, died in London, Aug. 6, 1864. She was her father's secretary in the latter part of his life. Besides numerous books for children and miscellaneous works, she published several novels, including "Modern Accomplishments" (1835); "Holiday House" (1839); "Modern Flirtations" (1841); "Jane Bouverie" (1845); "Lord and Lady Harcourt" (1850); "Beatrice" (1852); and "Torchester Abbey, or Cross Purposes" (1855).

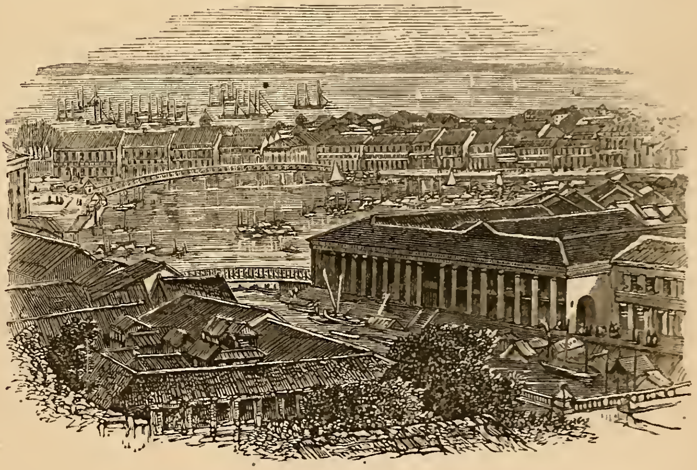
**SINDE, Scinde,** or **Sindh,** an administrative division or commissionership of the province of Bombay in British India, bounded N. by Beloochistan and the Punjaub, E. by Rajpootana, S. by the great western Runn of Cutch and the Indian ocean, and W. by the Indian ocean and Beloochistan; area, 54,403 sq. m.; pop. in 1872, 1,730,323. The sea coast, 150 m. in length, is low and swampy, except at its N. extremity, and at high water the shore is overflowed for a considerable distance inland. The interior is a vast and arid plain of sand and shingle, traversed throughout its entire length by the river Indus, with a belt of fertility on each side. Sinde and the Indus bear a striking resemblance to Egypt and the Nile. (See Indus.) The Hala hills extend along the W. frontier, but the most elevated points do not exceed 1,500 ft. above the sea. The E. part of Sinde is to a great extent desert, and covered with shifting sand hills, but affords some pasturage, more particularly for camels. In the north there are extensive tracts of jungle, now utilized as government fuel reserves. Upper Sinde and Lower Sinde are the respective designations of the northern and southern portions of the division, which comprises politically the collectorates of Kurrachee and Shikarpoor on

the W. side of the Indus, the collectorate of Hydrabad and the frontier district of Upper Sinde, bordering the river on the east, the native state of Khyerpoor between them, and the political superintendency of Thur and Parkur in the S. E. corner. The chief towns are Kurrachee, the seaport of the Indus, Hydrabad, the capital, Sukkur, Shikarpoor, and Larkhana, all organized municipalities except the first. The climate is hot, subject to sudden and great changes of temperature, and remarkably dry. Its aridity is due to the fact that the S. W. monsoon does not blow over Sinde, where the normal yearly rainfall is less than 15 inches, although the dews are exceedingly heavy. At Hydrabad the mean temperature of the six hottest months is 98°, but in winter frost is not unknown. In December, January, and February, a temperature of 32° F. at dawn is not unfrequently followed by a midday temperature of from 75° to 86° in the shade, at Kurrachee. Upper Sinde is tolerably healthful, and many of the natives attain a great age; but in the lower country, particularly toward the mouth of the Indus, there is much malaria and fever. Salt is the chief mineral product of the country, and alum, which is used to clarify the water of the Indus for drinking, occurs in considerable quantities. The soil of the delta of the Indus is a light clay mixed with sand, and the whole valley is fertilized by the annual inundation of the river; but away from the streams the surface is for the most part a sandy desert, or consists of vast tracts overspread with acacia-like trees, salvadora, and a leafless caper shrub. The forests of Sinde comprise the babul (*acacia Arabica*), the tamarisk, and the Euphrates poplar, and border the Indus at various points, having formerly been the favorite hunting grounds of the ameers; they cover an area of 350,000 acres. Irrigation is essential to cultivation, and the canals for that purpose are kept up at great expense, owing to the accumulation of silt. The only perennial canal in the division is above Sukkur, and is 24 m. long; all the others are inundation canals. Cotton is now grown experimentally, and sugar cane and tobacco succeed well, besides rice, wheat, barley, mustard, and the other common crops of such a climate; but the methods of agriculture are inferior and carelessly applied. The zemindary land revenue system prevails, under which the land is cultivated on shares. The fauna of Sinde is remarkable for number and variety. Tigers and leopards, hyænas and jackals, buffaloes, hog-deer, antelopes, and wild boars are prominent among the mammals. Among the very numerous species of birds are two eagles, bustards, falcons, partridges, quails, snipe, cormorants, herons, flamingoes, pelicans, and wild ducks of many sorts. The fresh waters yield the gavial, a so-called river porpoise which weighs upward of 200 lbs., and many varieties of fish; while pearl oysters are abundant along the coast. The common insects are locusts, ants, mosquitoes, and black flies.—The Sindians are tall, well made, and handsome, and the women are remarkably good-looking. They are made up of mixed races, principally Jats and Beloochees, the proportion of Mohammedans to other sects in the population being as four to one. The people are described as idle, exceedingly immoral, ignorant, and bigoted. Wool raising is an important industry. Some manufactures are carried on in the principal towns, and the people are very ingenious workmen. Coarse silk goods are made from materials imported from Persia and China, and a peculiarly soft and durable leather, several different kinds of cloth, earthenware, and cutlery are manufactured. The foreign trade in 1872–'3 was worth nearly £1,000,000, comprising exports valued at £657,994, and imports worth £324,250; and the coast trade was valued at £2,640,561. Some traffic is carried on with Cabool through the Bolan pass, but in Lower Sinde there are no regular highways, as the constantly shifting sand renders it difficult to maintain them. A railroad connects Kurrachee and Hydrabad, and the Indus valley line, which is to unite it with the railway system of India, is in process of construction. The government of Sinde is administered by a special commissioner.—Khyerpoor, the only native state in the division, extends 120 m. in length and 70 m. in width, between the Indus on the west and the Rajpoot state of Jessulmeer on the east, and is a great alluvial plain watered by six canals and having an area of 6,109 sq. m.—When Alexander the Great invaded India, Sinde was ruled by Hindoo princes, who had extended their conquests over all the countries lying between the Indus and the Ganges. Little is known of Sinde from that time till about A. D. 715, when it was conquered by a Mohammedan army sent from Bassorah; but these invaders did not long hold it. It was subsequently governed by a Rajpoot tribe for nearly three centuries, and was then conquered by Mahmoud of Ghuzni, whose successors held it until they were overthrown by the house of Ghore. About 1225 it fell under the dominion of the rulers of Delhi, who held it for upward of a century. They were succeeded by native princes, and about 1520 the country became subject to Shah Beg Argoon of Candahar. In 1592 it was incorporated with the Mogul empire under Akbar, in 1739 with the Persian under Nadir Shah, after whose death it reverted to the former, and in 1756 passed by dowry to the ruler of Cabool, remaining a nominal dependency of Afghanistan, though governed by native princes, till 1786, when a Belooche chief named Meer Futteh Ali obtained supremacy and divided the country into three independent states, each under several rulers known as ameers. Under these chiefs the government was a military despotism, and the relations between them and the English East India company were never very friendly.

About the beginning of the present century the company's agent was violently expelled, and a large amount of property in his custody confiscated. Subsequently several treaties were made; and in 1838, to facilitate the operations of its army in the contemplated Afghan war, the company extorted concessions from the ameers by which Sinde was made virtually one of its dependencies. The disasters of the British in Afghanistan having encouraged the ameers to commit hostile acts, a military force was sent thither under Sir Charles Napier, who, after concluding a treaty with the ameers of Lower Sinde, found himself compelled to take the field; the result was the brilliant victory of Meeanee (Feb. 17, 1843), the rapid conquest of the country, and the establishment of British authority. (See NAPIER, Sir CHARLES JAMES.) The rajah of Khyerpoor was allowed to retain his possessions, on account of his fidelity to the English. Sinde was constituted a commissionership in 1843.

**SINDIA, Family of.** See GWALIOR.

**SINGAPORE. I.** A province of the British colony of the Straits Settlements, consisting of the island of Singapore, and about 50 islets S. and E. of it in the strait of Singapore, lying between lat. 1° 8′ and 1° 32′ N., and lon. 103° 30′ and 104° 10′ E.; pop. in 1871, 97,111. The island of Singapore lies off the S. extremity of the Malay peninsula, from which it is separated by a strait about 40 m. long and ½ to 2 m. wide; it is about 25 m. long from E. to W., and 12 m. wide; area, 224 sq. m. On the coast are swampy tracts covered with mangrove trees, but inland are many small hills, from 100 to 500 ft. high. Iron ore abounds. Much of the soil is sterile, but in the lowlands it is richer. There are a few rivulets. Nutmegs, cloves, ginger, pepper, gambir, tapioca, and sugar cane are raised. The thermometer ranges from 71° to 89°, and the climate is healthful. Showers are frequent, and in 1871 the total rainfall was 120·4 inches. Tigers cross the strait to the island, and are said to carry off, on the average, a Chinaman every day. Of the inhabitants of Singapore in 1871, 74,351 were males and 22,763 females; 54,098 Chinese, 19,250 Malays, 9,297 Klings, 1,329 Europeans, 2,164 Eurasians, and the remainder natives of other parts of the East Indies. Malay is the prevailing language. **II.** A city, capital of the Straits Settlements, on the S. side of the island of Singapore, in lat. 1° 16′ 13″ N., lon. 103° 53′ 15″ E.; pop. about 90,000. It is on a low plain fronting the harbor, with hills in the rear, and is intersected by a salt-water creek called the Singapore river. On the W. side is the Chinese quarter, which contains also the great mercantile warehouses and counting houses. On the E. side are the official buildings, churches, hotels, and many of the European residences; and still further E. is the Malay quarter. Behind the Chinese quarter, on Pearl hill, is a fortress which commands it, and on another elevation, back of the European quarter, is the government house, a fine building of cut stone. Many neighboring hills are occupied by country houses. Near the shore are ample parade grounds and drives. The botanical garden has a splendid collection of tropical plants. Among the public buildings are the Singapore institution for the study of the languages of the East, which



Singapore.

contains a museum, library, and reading room; a prison, in which are generally confined about 2,000 criminals, mostly Hindoos, who are employed on government works; Protestant and Roman Catholic churches, a splendid Chinese temple, and a Mohammedan mosque. There are two mission schools, attended chiefly by Chinese, Malays, and Eurasians. The Chinese have also private schools. The port of Singapore, which is divided into two by a tongue of land, is capacious, and the water is deep enough for the largest vessels. The harbors are provided with every facility for an extensive commerce, and for fitting out and repairing ships. Singapore is a free port. Vessels pay three cents a ton light dues on entering and leaving. In consequence of its geographical position, it is the entrepot of the commerce of S. Asia and the Indian archipelago, and is resorted to by vessels of all nations. The entrances in 1872 were 1,665, tonnage 918,652; 729 were

steamers, tonnage 612,929. The total value of imports was $43,415,383; exports, $39,020,-121. During the year ending Sept. 30, 1874, 29 United States vessels entered; the total value of the exports to the United States for the same period was $3,750,831. The exports are tin, gambir, pepper, rattans and Malacca canes, coffee, nutmegs, tapioca, sago, caoutchouc, gutta percha, sapan wood, buffalo hides, and gums.—The city of Singapura ("lion's town"), capital of a Malayan kingdom, occupied the site of Singapore in the 12th century. In the 13th century it was captured by a king of Java, when the royal residence was removed to Malacca, and it gradually fell into decay; and in 1819, when the British built a factory on the site, the whole island had only 150 inhabitants. In 1824 the sultan of Johore, in consideration of $60,000 and a life annuity of $24,000, transferred the sovereignty and fee simple of the island, and all the seas and islands within 10 geographical miles, to the British. (See Straits Settlements.)

**SING SING,** a village in the township of Ossining, Westchester co., New York, beautifully situated on high ground on the E. bank of the Hudson river, at its widest part, called Tappan bay, 30 m. above New York; pop. in 1875, 6,500. There are several manufactories, the principal being two of files, one of lawn mowers, two of carriages, one of Brandreth pills, and one of porous plasters. The village contains a national bank, a savings bank, a public school, a Roman Catholic school, a female seminary, a school for preparing boys for West Point, three military schools, 12 private schools, two weekly newspapers, and six churches. It is the seat of one of the state prisons. The male division was erected by convicts, the first draft of whom, from Auburn state prison, began work in May, 1825. It contains 1,200 cells, is 484 ft. long by 44 ft. wide, and six stories high, with ranges of workshops running at right angles, 40 ft. wide and two and three stories high. The female division, with 120 cells, is on the E. side of the male division, and under separate management; it was begun in 1835. Both buildings are of white marble. (See New York, vol. xii., p. 367.)

**SINIGAGLIA** (anc. *Sena Gallica*), a town of central Italy, in the province and 18 m. N. W. of the city of Ancona, at the mouth of the Misa in the Adriatic; pop. in 1872, 22,197. It is the seat of a bishop, and has a beautiful cathedral. The ramparts are protected by a citadel. The port admits only small craft. The annual fair, July 20 to Aug. 8, at which large transactions are made in silk, is of great antiquity. The town was plundered by the troops of Pompey in 82 B. C. Under the exarchs of Ravenna it was for some time one of the cities of the Pentapolis, but afterward fell into decay. It is the birthplace of Pius IX.

**SINOPE** (Turk. *Sinub*), a fortified seaport town of Asia Minor, in the Turkish vilayet of Kastamuni, on the S. shore of the Black sea, 325 m. E. N. E. of Constantinople; pop. about 10,000. It stands on an isthmus which connects the mainland with a high rocky peninsula called Cape Sinope, forming on its S. E. side a roadstead, which is the best anchorage on that shore. The town has an arsenal and the only ship yard in Turkey except that at Constantinople, and many Turkish war vessels are built there. There is a massive castle erected in the time of the Greek emperors, and new fortifications are nearly completed (1876). It is a coal depot for steamers between Constantinople and Trebizond. Oak timber is largely exported.—Sinope became important after its second colonization from Miletus, about 630 B. C., and continued independent till 183, when it was captured by Pharnaces, king of Pontus, of which country it became the capital. It was much ornamented and improved by Mithridates the Great. Having been conquered by the Romans, it was made a colony by Cæsar. It was taken by the Turks in 1461. In the Crimean war the Turkish fleet, with the exception of one steamer which escaped, was destroyed here by the Russian fleet under Nakhimoff, with a loss of about 4,000 men, Nov. 30, 1853. The town was bombarded and suffered very severely.

**SINTO,** or **Shinto.** See Japan, vol. ix., pp. 537 and 562.

**SIOOT,** or **Osioot** (anc. *Lycopolis*), a city of Egypt, capital of a province of the same name, and residence of the governor of Upper Egypt, near the left bank of the Nile, about 250 m. above Cairo, under a hilly ridge of sand cliffs, which have been extensively excavated; pop. about 25,000. A magnificent embankment studded with trees leads to the town, which has several beautiful mosques and good bazaars; but the streets are narrow and unpaved, and most of the houses are mere hovels. There are successful schools under the care of American missionaries, and British and American consular agents. Sioot was formerly much frequented by caravans from the interior. The most important manufacture is that of pipe bowls. There are ruins here of a Roman amphitheatre, vast rock tombs of the 12th dynasty, and ancient alabaster quarries in the opposite range of hills. The city was once devoted to the worship of the wolf, or of the deity to which that animal was sacred, from which its ancient Greek name is derived.

**SIOUX,** or **Dakotas,** a tribe of American Indians, dwelling near the head waters of the Mississippi when first known by the whites. In 1640 the Algonquins informed the French of them as the Nadowessioux, whence they came to be called Sioux. In 1660, or soon after, the Chippewas and Hurons began a war with them, which continued into this century. In 1680 Duluth set up the French standard in their country at Izatys near the St. Peters. In the next year he rescued Hennepin from them. Nicolas Perrot, having entered their

domain in 1685, took formal possession for France in 1689, erecting a breastwork near Lake Pepin. In 1689–'99 Le Sueur visited the Dakotas, and describes them as divided into seven eastern and nine western tribes. They joined the Foxes against the French, and in war with the Chippewas many were forced down the Mississippi, and, driving other Indians from the buffalo plains, took possession of them. Several bands wandered into the plains of the Missouri. Some remained at or near the St. Peter's. The English agents secured the services of the Sioux in the war of 1812; but most of the bands soon made peace. The treaties then made were renewed in 1825 by the Tetons, Yanktons, and Yanktonais, Siounc, Ogallalas, and Oncpapas. The nation, estimated in 1822 at 5,000 on the St. Peter's and 7,750 on the Missouri, comprised the Aldewakantonwans, or Spirit Lake village; the Wahpetonwans, or village in the Leaves; the Sisitowans, or village of the Marsh, called also Isantis; the Yanktonwans, or End villages; and the Tetonwans, or Prairie village, which includes the Ogallala and Oncpapa bands. Their territory extended from the Mississippi to the Black hills, and from Devil's lake to the mouth of the Big Sioux. On Sept. 29, 1837, the Dakotas ceded to the United States, for $300,000 and some minor payments, all their lands east of the Mississippi. The American board began missions among the Wahpetonwans near Fort Snelling in 1835, and the Methodists in 1836. Schools were introduced, and elementary books printed in the language. In 1851 the nation ceded to the United States all their land east of a line from Otter Tail lake through Lake Traverse to the junction of the Big Sioux and the Missouri, retaining a reservation 20 by 140 m.; 35,000,000 acres were thus acquired for $3,000,000. The government's neglect to carry out the provisions of these treaties caused bitter feelings, and in 1854 Lieut. Grattan, in the attempt to arrest a Dakota, attacked a village and was cut off with his whole party. A series of hostilities by some of the Sioux ensued; but Gen. Harney defeated them on Little Blue Water, Sept. 3, 1855, and a general council at Fort Pierce consented to a treaty of peace. But in July, 1857, the band of Inkpadutas massacred 47 whites near Spirit lake, Iowa, and murders were committed elsewhere. Five whites were killed at Acton, Minnesota, Aug. 17, 1862. Enraged by the failure of annuities and the frauds practised on them, the Sioux then made a general uprising and killed nearly 1,000 settlers. New Ulm, a town of 1,500 people, was abandoned and almost destroyed.. Fort Ridgely was besieged, and was saved with difficulty. The Sioux of the Missouri and the plains also became hostile, and were reduced by Gen. Sibley of Minnesota and Gen. Sully of the United States army. After a severe struggle a number of captive white women and children were rescued, and many Indians captured and sent to Davenport. Of more than 1,000 Indians held captive, many were tried and condemned, but only 39, convicted of specific acts, were executed; the others were finally released. Many bands fled into Dakota territory, and the war, disease, and want largely reduced the nation. In 1863 the Minnesota Sioux were removed to Crow creek. About 1866 treaties were made with nine bands, promising them certain annuities, to be enlarged as they should give increased attention to agriculture. An act of Feb. 11, 1863, annulled all previous treaties with the Sioux; but to the innocent bands a part of the amount pledged was restored, the government reserving compensation for damages. The most guilty bands fled north, and are still in the British territory. A few bands continued longer in hostility, cutting off Lieut. Fetterman and his party in December, 1866, and besieging for a time Fort Phil Kearny. In 1874 the Dakotas comprised the Santee Sioux in the reservation at the mouth of the Niobrara, Nebraska, numbering 791, with five schools under the care of the Episcopalians and the American board; the Yankton Sioux on the Missouri, with the same missionaries; the Sissetons and the Wahpetons at Lake Traverse and Devil's lake; the Oncpapas, Blackfeet Sioux, Lower and Upper Yanktonais, Sans Arcs, Upper and Lower Brulés, Two-Kettle, Minneconjous, and Ogallalas in the Crow creek, Grand river, Whetstone, Cheyenne river, and Red Cloud agencies, 46,342 in all, in Dakota; Santee, Yanktonais, Oncpapa, and Cuthead Sioux at Milk river agency, Montana, 5,309. In 1873 the government liabilities to the Dakota tribes, including payments not yet due, were estimated at $10,387,800, with annual payments for their benefit of $27,400. A treaty hastily made by Gen. Sherman, April 29, 1868, was unsatisfactory on both sides; and as gold had been discovered in the Black hills, the United States wished to purchase the tract, and induce the Sioux to abandon their hunting grounds south of the Niobrara, or even to emigrate to the Indian territory. The Sioux showed great reluctance to treat. Sitting Bull, Red Cloud, and Spotted Tail, with other chiefs, visited Washington in May, 1875, but President Grant could not induce them to sign a treaty. Commissioners deputed by him met an immense gathering of the Sioux at the Red Cloud agency in September; but as the Sioux set an exorbitant price on their lands, the negotiation failed. Hostile feelings have been excited by alleged frauds at the Sioux agencies, which have been investigated, but as yet (1876) without result.—Much attention has been given to the Dakota language. A very good grammar and dictionary by Riggs have been issued by the Smithsonian institution. The missionaries have also supplied portions of Scripture, hymns, catechisms, and educational works in it, and newspapers issue lighter reading. It lacks the sounds *f*, *r*, *v*, but has peculiar sounds of its own.

**SIOUX**, a N. W. county of Iowa, bounded W. by the Big Sioux river and intersected by Rock river and affluents of Floyd's river; area, about 750 sq. m.: pop. in 1870, 576. The surface is nearly level and the soil productive. The Sioux City and St. Paul railroad passes through it. Capital, Calliope.

**SIOUX CITY**, a city and the county seat of Woodbury co., Iowa, on the Missouri river, between Perry and Floyd's creeks, at the intersection of the Sioux City and Pacific, Sioux City and St. Paul, Illinois Central, and Dakota Southern railroads, 156 m. N. W. of Des Moines; pop. in 1870, 3,401; in 1875, about 5,500. The business portion of the city is built upon a dry, well drained bench, which almost imperceptibly slopes N. from the river. N. and W. of the thickly settled part of the city rise low ranges of bluffs, upon whose sides are built some of the finest residences. The streets cross each other at right angles, and the principal ones are graded and furnished with sidewalks. The city is lighted with gas and has a fire department. It has an extensive trade with N. W. Iowa, N. E. Nebraska, and S. Dakota. There are four grain elevators, a pork-packing establishment, a national bank, a private bank, a savings institution, three saw mills, two flouring mills, a foundery and machine shop, three breweries, a gun factory, marble works, &c. The workshops of the Sioux City and St. Paul railroad employ about 75 men. The city has two fine graded school buildings and three or four ward school houses, attended by about 1,000 pupils; one daily and three weekly (one German) newspapers; a public hall, seating 1,000 persons; a library association; and six churches.—Sioux City was laid out in 1854 and incorporated in 1857.

**SIR DARYA.** See JAXARTES.

**SIREDON.** See AXOLOTL.

**SIREN**, a North American long-tailed batrachian, with stout eel-like body, naked skin, persistent branchiæ, and only the two anterior legs. The best known species, the *S. lacertina* (Linn.), or mud eel, has a small and short head, with elevated forehead and depressed and truncated snout, three branchial tufts, and three spiracles on each side; the mouth is small, with distinct lips, and arrow-shaped tongue free at the tip and sides; no teeth in the upper jaw, but a broad band of very minute ones along the outer border of the palate bones; nostrils and eyes small, the latter black; the tail laterally compressed, with a rayless fin above and below; limbs with four short and small fingers with horny tips. It attains a length of from 2 to 3 ft., and is dusky above with numerous whitish spots, and purplish below; it lives chiefly in the mud and muddy water of the Carolina rice fields, and occasionally comes on land. Its food consists of worms, insects, and the eggs of fish and frogs; it is found from lat. 35° N. to E. Florida. In this group there are about 90 vertebræ, connected by conical cavities filled with a gelatinous substance, as in fishes; eight pairs of short ribs, of which the first pair is attached to the second vertebra; no trace of pelvis; three cartilaginous branchial arches attached to an osseous tongue bone; the lungs two long sacs, accessory to the gills, but, as in the menobranchus, insufficient for respiration.

**SIREN**, in acoustics. See LIGHTHOUSE, vol. x., p. 458, and SOUND.

**SIRENIA**, an order of placental mammals containing the dugong and manatee, formerly called herbivorous cetaceans. They are whale-like in the swimming paddles of the anterior limbs, the absence of the posterior, and in the transverse tail fin; they differ from cetaceans in having the nostrils at the anterior part of the muzzle, molar teeth with flat crowns adapted for a vegetable diet, a head not disproportionately large, a tolerably distinct neck, more fleshy and bristly lips, and more hairy body.

**SIRENS** (Gr. σειρῆνες, from σειράειν, to draw, to entice), mythical female beings who enchanted the listeners to their song, and after getting them into their power destroyed them. In the legends of the Argonauts they are said to have endeavored to entice those wanderers, but Orpheus surpassed them in singing; thereupon they threw themselves into the sea, and were changed into rocks, as it had been fated that they were not to live after any one passed by them unaffected. In Homer the sirens are connected with the voyage of Ulysses, who, preparatory to sailing by the islands on which they were sitting, by the advice of Circe plugged the ears of his companions with wax and fastened himself to the mast of the vessel, until he was out of the sound of their voices. The island in Homer's account was between Ææa and the rock of Scylla, in the strait of Messina; but the Roman poets place them near the shore of Campania, in the island of Capreæ (Capri) or in the Sirenusian islands near Pæstum. They were called daughters of Phorcus, of Achelous and Sterope, of Terpsichore, of Melpomene, of Calliope, or of Gæa. While Homer mentions only two sirens, the later traditions assume that there were three, and sometimes four. In later times they were represented as birds with the face of a woman. —See Schrader, *Die Sirenen im Alterthum* (Berlin, 1868).

**SIRHIND. I.** A geographical designation applied to that part of India lying between the upper courses of the Sutlej and the Jumna, but not now coterminous with any political division, being for the most part a plain sloping from N. E. to S. W., and having an area of about 17,000 sq. m. In the extreme northeast a spur of the Himalaya, which divides the head waters of the Sutlej from those of the Jumna, projects into the territory, which is bounded N. and S. by certain outlying districts of the Punjaub, E. by the Northwest Provinces, and W. by Bhawalpoor. It comprises the Punjaub districts of Ambala, Loodiana, Ferozepoor, Sirsa, Hissar, and Kurnal,

as well as nine independent native Cis-Sutlej states in subsidiary alliance with the British government, as follows: Patiala, area 5,412 sq. m., pop. 1,650,000; Jhind, 863 sq. m., pop. 189,475; Nabha, 863 sq. m., pop. 227,-155; Kalsia, 155 sq. m., pop. 62,000; Maler-Kotla, 165 sq. m., pop. 46,200; Furidkot, 643 sq. m., pop. 68,000; Dyalgurh, Mumdot, and Raikot. Separate from the group, on the banks of the Beas, but usually classed with the Sikh states of Sirhind, is the state of Kapurthala, with an area of 598 sq. m.; pop. 253,-293. The Sikhs predominate, except in Maler-Kotla, which is Mohammedan, and Furidkot, where the ruler is a Jat. Sirhind is traversed by the Saraswati, Ghaggar, and other affluents of the Sutlej, but, although fertile, requires additional irrigation, which will be supplied by the canal system now in process of construction by the government, to have a total length of 554 m. The Feroze canal, in the S. part of Sirhind, was originally constructed from the Jumna to Hissar by Feroze Shah (1351–'87), in order to water his hunting grounds, and has been restored by the British. The railway from Delhi to Lahore crosses Sirhind. Those portions of the Punjaub directly subject to the government of India were mainly acquired during the Sikh wars. The sovereign states were guaranteed their independence, under British protection, by treaty with Runjeet Singh in 1809. **II.** A town in the Sirhind state of Patiala, lat. 30° 36′ N., lon. 76° 25′ E., founded by Feroze Shah in 1357, and once an important city, but subjected to repeated captures during the Sikh wars, and now largely in ruins. It is on the line of the Delhi railway.

**SIRIUS.** See Dog Star.

**SIRMOND, Jacques,** a French scholar, born in Riom in October, 1559, died in Paris, Oct. 7, 1651. He was a Jesuit, and in 1590 became secretary to the general of the order, Claudio Acquaviva. In 1608 he went to Paris to edit a collection of the histories of the French church councils. In 1637, to prevent his returning to Rome, he was chosen by Louis XIII. as his confessor. He was involved in controversies with Salmasius, Saint-Cyran, and others. His principal original works are: *Notæ Stigmaticæ* (4to, Frankfort, 1612), directed against Richer's work on the temporal and spiritual powers; *Concilia antiqua Galliæ* (3 vols. fol., Paris, 1629); and *Historia Pœnitentiæ Publicæ* (1651). A collected edition of his works appeared in 1696 (5 vols. fol.), with a life of the author by Labaune. He published many editions of ancient authors.

**SIROCCO,** or **Scirocco,** a S. E. wind of a suffocating and parching heat, which at certain intervals, especially in spring and autumn, blows with great violence in the islands of the Mediterranean and on the S. coasts of Italy, for 36 or 48 hours together, and sometimes even for a week or more, and which exerts a most pernicious influence on animal and vegetable life. It is regarded as similar in character to the simoom, though of longer duration, and tempered while passing over the Mediterranean. It is hottest in Malta and Sicily, but of short continuance. In the Ionian isles it blows for a longer period, but usually not so fiercely. The inhabitants of these isles speak of the black and the ordinary sirocco. It produces very little change either in the thermometer or the barometer, but causes a sensation of terrible heat and suffocation, great prostration, and copious perspiration.

**SISKIN.** See Aberdevine.

**SISKIWIT.** See Trout.

**SISKIYOU,** a N. county of California, bordering on Oregon; pop. in 1870, 6,848, of whom 1,440 were Chinese. It formerly had an area of 8,740 sq. m., extending from Nevada to W. of the Coast mountains; but in 1874 the E. portion was set off to form Modoc co. It is intersected by the Klamath river, and watered by several of its tributaries. The surface is elevated. Mt. Shasta in the S. part, in the transverse range joining the Sierra Nevada and Coast mountains, is an extinct volcano, 14,442 ft. high, and covered with perpetual snow. The principal agricultural district is Scott's valley, 40 m. long by 7 m. wide. The chief productions in 1870 were 116,107 bushels of wheat, 131,383 of oats, 55,138 of barley, 17,066 of potatoes, 43,858 lbs. of wool, 95,800 of butter, and 12,392 tons of hay. There were 4,654 horses, 24,254 cattle, 12.844 sheep, and 7,499 swine; 8 flour mills, and 8 saw mills. Capital, Yreka.

**SISMONDI, Jean Charles Léonard Simonde de,** a French historian, born in Geneva, May 9, 1773, died there, June 25, 1842. He was the son of a Protestant clergyman, and of remote Italian descent. After completing his classical studies, he was placed in a commercial house at Lyons. He subsequently resided with his family in England for some time, and having returned to Geneva about 1794, he and his father were driven into exile for assisting a political refugee. He returned to Geneva in 1800, became a secretary of the chamber of commerce, and published in 1803 *Traité de la richesse commerciale, ou principes d'économie politique* (2 vols. 8vo). In this work he supported the principles of Adam Smith, but his views afterward underwent a radical change. The influence of Mme. de Staël, whom he accompanied to Germany and Italy, and of her friends, turned his attention to historical labors, in which he revealed his ardent love of humanity. In 1819 he married Miss Allen, a sister of Sir James Mackintosh's second wife, and declined chairs at the Sorbonne and the collége de France, to spend the rest of his life at Geneva. His principal works are: *Histoire des républiques italiennes du moyen âge* (16 vols., Zürich, 1807–'18; new ed., 10 vols., Paris, 1840); *La littérature du midi de l'Europe* (4 vols., 1813; 4th ed., 1840; English translation by Thomas Roscoe, with notes, 4 vols., 1823); *Nouveaux principes d'économie politique* (2 vols., 1819); *His-*

*toire des Français* (31 vols., 1821–'44; vols. xxx. and xxxi. by Amédée Renée, the last forming a general index); *Julia Severa, ou l'an 492*, a picture of Gaul during the 5th. century (3 vols. 12mo, 1822); "History of the Italian Republics," an eloquent summary of his great work on the same subject, and "The Fall of the Roman Empire," both originally written in English for Lardner's "Cabinet Cyclopædia" (1832 and 1834), and translated by himself into French; *Études sur la constitution des peuples libres* (1836; enlarged ed., entitled *Études des sciences sociales*, 3 vols., 1836–'8); and *Précis de l'histoire des Français* (2 vols., 1839), a summary of his larger work, bringing it down to the death of Henry IV.—See "Political Economy and the Philosophy of Government," selected from his works, with a notice of his life and writings by Mignet (London, 1847); *Sismondi, fragments de son journal et de sa correspondance avec Mlle. de Sainte-Aulaire* (Paris, 1863); and his *Lettres inédites à Madame d'Albany* (1864).

**SISTERHOODS. I. Roman Catholic**, associations of women bound together by religious vows, and devoted to works of charity. In this article only those sisterhoods are mentioned which profess to embrace exclusively or in a very special manner hospital work, and the care of the aged or infirm poor, orphans, and penitent women. The history of religious orders of women whose principal object is the pursuit of ascetic perfection, forms a part of the history of the great contemplative orders on which they depend for their origin, name, and spiritual guidance. (See MONACHISM, RELIGIOUS ORDERS, and special articles on the several orders.) Female congregations whose sole purpose is the instruction of youth, or who embrace at the same time works of public charity, are treated under SCHOOL BROTHERS AND SCHOOL SISTERS.—In the 5th century mention is made by ecclesiastical writers of associations of women at Rome, Milan, and other chief cities of the Roman empire, who gave up their wealth and time to the relief of the suffering poor. Congregations of female hospitallers existed throughout western Europe, dependent on the communities of canons regular, professing like these the rule of St. Augustine, and subject to the same changes and reforms. The earliest known sisterhoods of extensive influence, devoted solely to hospitality or hospital work, are the sisters of St. John of Jerusalem and the sisters of St. Lazarus. The former had a utility coextensive with that of the knightly brotherhood of the same name; the latter especially professed to care for lepers, incurables, the plague-stricken, and persons afflicted with every form of loathsome disease. The order of St. Lazarus is contemporaneous with the hospitallers of St. John of Jerusalem. A guild of men and women were in charge of several leprosy hospitals in that city when it was conquered by the crusaders; they were organized soon afterward into a religious order under the rule of St. Augustine, and their establishments multiplied rapidly both in the East and the West. The first female leprosy hospital in France was founded at St. Denis, near Paris, in 1109, by Louis VI., who also opened several others in various parts of the kingdom, among them one at La Saussaie, near Villejuif, and another at Étampes, besides founding many in the East. The sisterhood was recruited from among the nobility; and Henry II. of England, in founding a hospital for female lepers at Rouvray, near Rouen, stipulated that none but noble ladies of the sisterhood of St. Lazarus should belong to the community in charge of the lepers. The sisterhood also found protectors in Richard I. of England, St. Elizabeth of Hungary, Louis VII., Louis VIII., and Louis IX. of France, all of whom encouraged the daughters of the nobility to enter it. The popes bestowed many privileges on the sisters, and they soon spread throughout England, Germany, Poland, Italy, and Spain. Among the most noted Augustinian sisterhoods in France is that of the hospitallers of the Hôtel-Dieu in Paris, which existed at least as a guild before Charlemagne, and was formally organized as a religious community under Louis le Débonnaire in 814. Their numbers had to be repeatedly recruited during the "black plague" in 1348. Similar sisterhoods, all governed by the rule of St. Augustine, had charge from the beginning of the other Parisian hospitals, and of those founded since that period in French cities and in all the French colonies. Other nurseries of hospitallers in the 13th century were the abbey of Longchamp near Paris, the community of "Quinze Vingts" founded by St. Louis, as well as the Maison Dieu, and the *hostelleries des postes* for strangers and travellers, all in Paris, besides similar foundations by the same king in other parts of France. From these Augustinian communities came the hospitallers of the Hôtel-Dieu (1639) and general hospital (1693) in Quebec, as well as those of the Hôtel-Dieu of Montreal, founded in 1659 by a colony of nuns from La Flèche. Four sisterhoods devoted to hospital work and the care of the poor under the title of the "Presentation" have existed: one founded in 1627 by Nicolas Sanguins, bishop of Senlis, approved by Urban VIII., but which only possessed a few establishments; a second in Paris, with the mitigated rule of St. Benedict; a third and more important order, founded by Cardinal Federigo Borromeo (died 1631) at Morbegno in the Valtellina, living under the Augustinian rule, and very popular in the north of Italy; and a fourth founded in Ireland and described in the article SCHOOL BROTHERS AND SCHOOL SISTERS. In England, the Gilbertine nuns, founded about 1170 by St. Gilbert of Sempringham, embraced hospital work with every other form of public charity. They numbered 1,200 in 1189.—In the year 1100 arose in France the order of Fontevrault, which united the care of leprosy hospitals with that of asylums for fallen

women. These were all placed under the protection of St. Mary Magdalen, and, spreading rapidly with the order itself, effected a great moral reform in France and elsewhere. The "Sisters of Penitence" originated at Marseilles in 1278, and were specially devoted to the same purpose. A host of similar sisterhoods arose afterward, among which were the "Sisters of Charity" established at Marseilles in 1290, who soon opened houses in the chief cities of southern France; the Jesuates of St. Jerome, founded in 1358 at Siena, approved by Pope Martin V., and suppressed by Clement IX.; the "Congregation of Our Lady of Charity" in Paris; and the numerous communities of noble ladies popularly known as Magdelonettes, but united under the patronage of St. Mary Magdalen, established at Metz in 1452, at Paris in 1492, at Naples in 1524, and at Rouen and Bordeaux in 1618. In the Magdelonette establishments, the women under care of the nuns were classed in three categories: the congregation of St. Martha, formed of persons supposed to be thoroughly reformed, and permitted to bind themselves by religious vows; the daughters of St. Martha, who, though penitent, are not permitted to make vows; and the daughters of St. Lazarus, who are either unwilling to reform or are placed in the establishment by the public magistrates. Similar sisterhoods were organized at Rome by Leo X., and confirmed and endowed by Clement VIII. The congregation of the "Sisters of Our Lady of Providence," founded in 1830 for the same purpose in the south of France by Mlle. Lamouroux, has several large establishments, one of which is at Laval.—Of the communities whose sole care is that of the aged and homeless poor, two deserve special mention. The "Little Sisters of the Poor" were founded in 1840 at St. Servan in Brittany, by Abbé Le Pailleur, with the aid of two poor girls. They give a home to the aged of both sexes, depending solely on the alms collected from door to door and on the labor of the sisterhood. They were much opposed at first, but were soon called to open houses in all the cities of France. They were approved by Pius IX., July 9, 1854, and recognized by the French government in 1856. A house was given to them in London in 1860, and their labors were warmly recommended by Charles Dickens and other public men, and from London they spread all over Great Britain and Ireland. In 1868 they came to Brooklyn, N. Y., Cincinnati, and New Orleans, in 1869 to Baltimore and St. Louis, and afterward to New York, Philadelphia, Louisville, and Boston. They also have establishments in Algeria, Asia Minor, and Constantinople. The other community is that of the "Sisters of the Poor of St. Francis," a congregation which originated at Aix-la-Chapelle in the present century, and came to the United States in 1857. Besides the care of the aged poor, they take charge of hospitals, into which they bind themselves to receive at all times and without distinction the sick and wounded of every creed and nationality. They have many establishments in most of the large cities of the United States.—Among the communities devoted to the care of the insane are the "Sisters of the Good Saviour" at Caen in Normandy. The community was founded in 1720 by two poor girls, who taught little outcast children, visited the poor, nursed the sick, and in 1730 opened asylums for homeless children, female penitents, and insane persons. They were suppressed in 1789, but continued to labor among the needy till May 22, 1805, when 15 sisters once more met in community under Abbé Jamet, their former chaplain. In 1817 and 1818 they were first charged by government with the care of insane women, and soon afterward with that of insane men. Besides, Abbé Jamet having invented a new method of instruction for deaf and dumb orphans, his school gradually became a normal school to which pupil teachers of the deaf and dumb resort from France, Belgium, and the British isles. In 1874 the mother house at Caen numbered 300 sisters and upward of 1,000 insane patients. There are three associated establishments of equal importance at Albi, Pont-l'Abbé, and Brucourt. In Canada, the care of the insane at Quebec devolved on the sisters of the general hospital till 1844; and the sisters of Providence founded at Montreal in 1828, and canonically approved in 1844, have charge of the insane asylum near that city. **II. Protestant.** In the church of England several communities of charitable women have been organized in the present century. A community of "Sisters of Mercy" was founded at Devonport about 1845 by Miss Lydia Sellon, who began with the establishment of industrial, infant, and ragged schools. Several ladies joined her in her work, and they took a house and formed a community under Miss Sellon, at first subject to the visitorial control of the bishop of Exeter. The society was composed of three orders, viz.: those living in community, working among the poor, and leading an active laborious life; those who were unable to undertake this work, but who wished to live a calm life, engaged in prayer, reading, and quiet occupations; and married and single women who lived in the world, but maintained a certain connection with the community, and assisted its work in various ways. The sisters were bound by no vows except a promise of obedience to their superior. They were free to abandon their vocation at will, but while connected with it adopted a peculiar garb, and shared their property in common. The sisters also undertook the entire charge and support of a large number of orphan children. At East Grinstead a sisterhood was founded in 1855 by the Rev. Dr. John Mason Neale, with the object of nursing the sick, poor and rich, in their own homes, and in hospitals or infirmaries, in town or country. In 1874 the society had branch houses in London, Aberdeen, Wigan,

and Frome-Selwood.—The parent house of the "Sisterhood of St. John the Baptist" was founded at Clewer in 1849. The sisters have there a house of mercy, St. John's orphanage, St. Andrew's convalescent hospital, St. Andrew's college for accommodating women recovering from illness or requiring change of air and nourishing food, and St. Stephen's mission, embracing an upper class boarding school, a middle class school for girls and boys, and an infant school. The sisterhood has established branches at London, Oxford, Torquay, Gloucester, and other places. This organization embraces: 1, choir and lay sisters living in community; 2, a second order formed in 1860 of ladies who enter on the sisters' life for periods of three years at a time, to be renewed continuously at their own desire and with the consent of the sisters; 3, associates, who live in their own houses and give such assistance to the work as their circumstances may permit. The "Sisterhood of St. Mary," Wangate, was established in 1850, and has branches at Bedminster, Plymouth, and other places. The "Sisterhood of St. Mary the Virgin" established its parent house at Wymering in 1859. The society consists of sisters of charity, who, being resident and under a religious rule, constitute the sisterhood, and ladies of charity or associates, who undertake to promote the interests of the society in their several spheres of private life. The sisterhood has established branches at Manchester and Aldershott. The "Sisterhood of St. Thomas the Martyr," which has its parent house at Oxford, has branches at Liverpool and Plymouth. The society of the "Sisters of the Poor," founded in 1851, has its parent house in London and branches at Edinburgh, Clifton, Eastbourne, and West Chester. —In the Protestant Episcopal church of the United States, an organization of women for voluntary service as nurses in hospitals, infirmaries, &c., called "Sisters of the Holy Communion," was founded in 1845 by the exertions of the Rev. W. A. Muhlenberg, D. D., in connection with the Protestant Episcopal church of the Holy Communion in New York. They are bound by no vows, and though it is desirable that they should remain in their work for life; they are free to leave whenever they are so minded. They are usually received between the ages of 25 and 40 years; if under 25, the written consent of parents or guardians must be obtained. Candidates for the sisterhood are required to spend one year of probation before entering upon their vocation. They have no marked uniform, though the dress is generally black, with a white muslin collar and head dress. The sisters managed for several years the infirmary of the Holy Communion, and since 1858 have had charge of St. Luke's hospital, New York, under Dr. Muhlenberg's superintendence. (See DEACONESS.)

**SISTOVA**, or **Shistov**, a fortified town of Bulgaria, on a height overlooking the right bank of the Danube, which is here navigable for vessels of 500 tons, 35 m. W. S. W. of Rustchuk and 23 m. E. by S. of Nicopoli; pop. about 15,000. It is defended by a citadel or castle, now much dilapidated. The houses are ill built, but the mosques are of considerable beauty. A treaty of peace between Turkey and Austria was concluded here Aug. 4, 1791.

**SISYPHUS**, in Greek mythology, son of Æolus and Enarete, and married to Merope, by whom he became the father of Glaucus and others. Some later accounts make him the son of Autolycus and the father of Ulysses. To him are attributed the foundation of Corinth (Ephyra) and the establishment of the Isthmian games. He and his family were considered the most deceitful of men, and he was punished in the lower world by being set to the task of rolling a huge marble block up hill, which as soon as it reached the top always rolled back again. The crimes which induced this penalty are, according to different legends, that he betrayed the plans of the gods, killed travellers, and revealed the abduction of Ægina by Jupiter.

**SITKA.** See ALASKA, vol. i., p. 239.

**SIVA.** See INDIA, RELIGIONS OF.

**SIVAS. I.** A vilayet of Turkey, in Asia Minor, bounded N. by Trebizond, E. by Trebizond, Erzerum, and Diarbekir, S. by Marash, Adana, and Konieh, and W. by Angora and Kastamuni; area, about 25,000 sq. m.; pop. estimated at about 600,000. The most important town, besides the capital, is Tokat, and its principal seaport is Samsun. It is traversed by several branches of the Anti-Taurus mountains. It is drained by the Kizil Irmak (anc. *Halys*), the Yeshil Irmak (*Iris*), and their affluents, and several smaller streams which flow into the Euphrates. Among the minerals are iron, copper, lead, alabaster, marble, slate, and especially salt. Most of the soil is exceedingly fertile, but not thoroughly cultivated. The pastures are extensive. In ancient times the province formed parts of Pontus and Cappadocia. **II.** A city (anc. *Sebastia*), capital of the province, in an extensive plain on the Kizil Irmak, 440 m. E. S. E. of Constantinople; pop. about 25,000. The town is defended by two old castles, and contains fine mosques and many ruins. Access from the Black sea is easy, and the trade is active in the large bazaars.

**SIVORI, Ernesto Camillo**, an Italian violinist, born in Genoa, June 6, 1817. At the age of four years he was able to perform whatever he heard his sisters play or sing. He received lessons successively from Restano, Dellepiane, Costa, and Paganini, but modelled his playing chiefly upon that of the last named. His first concerts were given at Paris and in England when he was but ten years old. He then studied counterpoint for eight years under Serra, and afterward gave concerts throughout Europe. In 1846 he visited the United States in company with the pianist Herz, and went also to Mexico and South America. Next engaging in a mercantile enterprise in Italy, he lost all his earnings and was obliged to resume

his artistic career. He has composed a number of concertos, fantasias, and other pieces.

**SIWAH** (anc. *Ammon* or *Ammonium*), an oasis in N. W. Egypt, near the boundary of the disputed territory between Egypt and Tripoli, about 330 m. W. S. W. of Cairo, and about 160 m. from the coast of the Mediterranean sea; pop. about 8,000. It consists of several detached tracts, the principal of which is about 8 m. long and 3 m. broad. Its surface is undulating, rising on the north into high limestone hills. There are numerous ponds and springs, salt and fresh. The soil of the E. part is exceedingly fertile, its chief product being dates. The climate is delightful. The inhabitants are Berbers and negroes, all Mohammedans, governed by sheikhs or elders, some of whom hold office for life, others for ten years. The people understand Arabic, but have a mixed idiom of their own. Their principal town, Siwah (according to Rohlfs, who last visited it in February, 1874, in lat. 29° 12′ N., lon. 25° 30′ E.), is defended by a citadel on a rock, and by strong walls. The streets are irregular, narrow, and dark. It is divided into an upper and a lower town. No stranger is admitted to the former, nor are native bachelors permitted to live there. About 3 m. S. E. of the town are the ruins of the ancient temple of Jupiter Ammon, now called Om Baydah, sculptures of Ammon, with the attributes of the ram-headed goat, being among the remains. Near the temple is what is supposed to be the fountain of the sun, a pool 80 ft. long and 55 ft. wide, formed by springs, whose water appears to be warmer by night than by day, and is heavier than that of the Nile. In the vicinity are other ruins and inscriptions of Greek, Roman, and Roman-Egyptian character. In the W. part of the oasis is a lake, called Birket Arashiah, containing an island from which strangers were till lately excluded.—In ancient times this oasis was celebrated as the seat of the oracle of Ammon. Besides the temple, with its images of Jupiter Ammon set in precious stones, it contained a royal castle surrounded by three walls, and a remarkable spring called the "fountain of the sun," the water of which was quite cold at noon and boiling hot at midnight. Cambyses made an unsuccessful attempt to take the temple. In 331 B. C. Alexander the Great marched through the desert to visit it, and the priest addressed him as the son of the god. The emperor Justinian built here a Christian church.—See *Reise zu dem Tempel des Jupiter Ammon und nach Oberägypten*, by Minutoli (Berlin, 1824); "Adventures in the Libyan Desert," by Bayle Saint John (London, 1849); and *Das Orakel und die Oase des Ammon*, by Parthey (Berlin, 1862).

**SIX NATIONS.** See Iroquois.

**SIX PRINCIPLE BAPTISTS,** a small religious sect which first appeared in this country as a separate organization in Rhode Island in 1639. Their church polity and views on baptism are the same as those of the Baptists. In doctrine they are Arminian. They oppose the payment of any regular salary to their preachers, and have never connected themselves with any missionary efforts, or benevolent or reformatory societies. They hold as their distinguishing doctrines the six principles laid down in Heb. vi. 1, 2, viz.: repentance from dead works; faith toward God; the doctrine of baptisms, of which they distinguish four kinds, viz.: John's baptism, the baptism of the Holy Ghost on the day of Pentecost, the baptism of Christ's sufferings, and apostolic or Christian baptism, which alone remains since the resurrection of Christ; laying on of hands, which they regard as equally necessary with baptism; the resurrection of the dead; and eternal judgment. In 1874 they had 20 churches, 12 ordained ministers, and 2,000 members, mainly in Rhode Island.

**SIXTUS,** the name of five popes, of whom the following are the most important. **I. Sixtus IV.** (Francesco d'Albescola della Rovere), born at Celle, near Savona, July 21, 1414, died in Rome, Aug. 13, 1484. He was a Franciscan monk and a protégé of Cardinal Bessarion, taught philosophy and theology in the principal schools of Italy, and was chosen general of his order in 1464. He was created cardinal Sept. 18, 1467, and was elected pope Aug. 9, 1471. The efforts which he immediately made to reform the religious orders and general church discipline were thwarted by his endeavor to unite all Christian princes in a crusade against the Turks, for which purpose he vainly tried to reconcile Louis XI. of France and Duke Charles the Bold of Burgundy. He levied tithes on all church property in Christendom to equip a fleet, which, with contingents from Venice and Naples, only succeeded in capturing Smyrna. Louis XI. promised assistance in return for an extension of the royal power over benefices and all church revenues, and the abolition of ecclesiastical courts and immunities; but on these points Sixtus refused to yield. He has been justly reproached, however, with a too great facility in granting favors, and an excessive nepotism. To secure the coöperation of the Spanish and Austrian princes against the Turks, he sanctioned the nomination to the see of Saragossa of a child six years old, an illegitimate son of the house of Aragon; and he raised successively to the cardinalate five of his own nephews. Two of these cardinals, Riario and San Giorgio, were implicated in the conspiracy of the Pazzi in 1478, which caused the pope to be solemnly arraigned by the Florentine clergy as privy to the intended murder of Lorenzo de' Medici and the death of his brother Giuliano. The Florentine magistrates having hanged Archbishop Salviati of Pisa, one of the conspirators, they were excommunicated, and the city was laid under interdict. The republic was sustained by France, Venice, and the duke of Milan; the other Italian sovereigns sided with the pope,

and the quarrel ended in 1480. About the same time Sixtus became involved in a war with Ercole d'Este, duke of Ferrara, whom he wished to dispossess in favor of one of his own nephews. He was backed by the Venetians; but the duke of Ferrara being supported by the king of Naples and the emperor, Sixtus was forced to yield in 1484. During these troubles the Turks besieged Rhodes and ravaged the southern coast of Italy, capturing the city of Otranto and massacring 12,000 of the inhabitants. The pope once more attempted in vain to organize a crusade, but succeeded in driving off the invaders. Among the other acts of his pontificate were the confirmation of the religious order of Minims, May 23, 1474; the bull sanctioning the Spanish inquisition, 1478; the canonization of St. Bonaventura, April 14, 1482; the construction, among many other splendid public works, of the Sistine chapel in the Vatican; large additions to the Vatican library; and the sending of the first missionaries to the Canary islands. The *Regulæ Cancellariæ Romanæ* are attributed to this pope. He also left several Latin treatises, among which are *De Sanguine Christi* (fol., Rome, 1473), *De Potentia Dei* (fol.), and several letters. **II. Sixtus V.** (Felice Perretti), born at Grotte-a-Mare, near Montalto, Dec. 15, 1521, died in Rome, Aug. 27, 1590. He was a Franciscan, and distinguished himself as a lecturer on ecclesiastical law at Rimini in 1544 and Siena in 1546, as a popular preacher, and as an author by works on mystical theology and on the philosophy of Aristotle. In 1557 he became inquisitor general at Venice, and in 1570 he was created cardinal, when he assumed the name Montalto. He was elected pope by an almost unanimous vote, April 24, 1585. Both as pope and as secular prince he was distinguished for prudence, severity, and energy. He destroyed the power of the banditti and restored order and safety throughout his territory, administered law with the utmost impartiality and with an appalling rigor, built a great aqueduct, enlarged the library of the Vatican, and in many other ways encouraged industry. He fixed the number of cardinals at 70, required the Catholic bishops of all countries to visit Rome at certain intervals, and reorganized the entire administration of ecclesiastical affairs by the appointment of 15 congregations of cardinals and other officers. He founded a new university at Fermo, and new colleges at Rome and Bologna. From the printing press of the Vatican he published the revised edition of the Vulgate, which had been ordered by the council of Trent. He avoided war with the Christian princes as much as possible, though he encouraged and supported Henry III. against the Huguenots, Philip II. against England, and Archduke Maximilian when he was a candidate for the crown of Poland. He hurled his anathemas against the young king of Navarre, and against Elizabeth of England for putting to death Mary Stuart; and he summoned Henry III. to Rome for ordering the assassination of the duke of Guise. He left a vast treasure in the castle of Sant' Angelo, to be used by his successors only in circumstances strictly defined. His biography by Leti (*Vita di Sisto V.*, Lausanne, 1669) is considered untrustworthy, and that by Tempesti (*Storia della vita e geste di Sisto V.*, Rome, 1754) too partisan.—See J. A. von Hübner, *Sixte Quint, sa vie et son siècle* (2 vols., Paris, 1871; English translation by Jerningham, London, 1872; German, 2 vols., Leipsic, 1874).

**SKAGER RACK** ("the crooked strait of Skagen"), an arm of the North sea or German ocean, lying between the Danish peninsula of Jutland and the coast of Norway, and connecting the Cattegat with the North sea. It extends from N. E. to S. W.; length about 160 m., breadth nearly 80 m. It is much deeper on the Norwegian than on the Danish coast, ranging on the former from 150 to 200 fathoms, and on the latter from 30 to 40. It is subject to severe storms. The harbors are all on the Norwegian coast.

**SKAMANIA**, a S. county of Washington territory, bordering on Oregon, bounded S. by Columbia river and drained by several streams; area, 1,800 sq. m.; pop. in 1870, 133. The surface is generally mountainous, with fertile valleys. The Cascade mountains traverse it from N. to S. Mt. St. Helens, in the N. W. part, is 9,750 ft. high. Capital, Cascades.

**SKATE** (Dutch, *schaats*), a shoe or sandal with a steel runner for travelling over ice. It probably originated in Scandinavia. The earliest skates were made of bone, fastened to the foot with cords. Such skates have been discovered in England, Holland, Sweden, and Iceland, and there are accounts of their use in London in the time of Henry II. The introduction of iron skates was doubtless due to the Dutch, who for an unknown period have used them for travel on their canals and rivers. The best facilities for skating are afforded by the countries of N. W. Europe, where the ice is little covered with snow; but as a pastime it has become widely popular, and is practised with great skill by both men and women. The form of the skate has been much improved. Until within a few years it was a block of wood with a runner or keel of iron or steel about an eighth of an inch thick, channelled at the bottom so that two sharp edges cut into the ice, ending in a sharp angle at the heel, and turning up at the toe. It was secured to the foot by a peg or screw entering the heel of the boot, and by straps passing through the block, crossing the front part of the foot, and connecting with a broad strap around the heel. In improved skates the runner is of steel, thicker, and flat instead of channelled at the bottom, the cutting edge forming a little less than a right angle. It is generally curved slightly from front to back, and rounded up at both heel and toe. There have been many changes in the form of the body of the skate and the fastenings, the straps sometimes giv-

ing place to what is almost a complete shoe, while one of the favorite skates is made wholly of iron or steel, without straps, and fastened to the boot by metal clamps. Motion on skates is very rapid. It is said that the Frieslanders will go for a long time at the rate of 15 m. an hour, and for short distances this rate has been greatly exceeded.—"Parlor" skates, having in place of runners rollers of wood, metal, papier maché, or India rubber, arranged in a line, or like the wheels of a carriage, are used on floors and pavements. With these skates experts can execute the ordinary curves, and even many intricate figures.

**SKATE,** a fish. See Ray.

**SKEAT, Walter William,** an English philologist, born in London, Nov. 21, 1835. He graduated at Christ's college, Cambridge, in 1858, became a fellow there in 1860, mathematical lecturer in 1864, and afterward English lecturer. In 1873 he helped to found the English dialect society, and he has edited most of its publications. Besides continuing for the Cambridge press the Anglo-Saxon Gospels begun by J. M. Kemble, and editing several publications for the Oxford press, the philological society, and the early English text society, he has published "The Songs and Ballads of Uhland," translated from the German (1864); "A Tale of Ludlow Castle" (1866); "A Mœso-Gothic Glossary" (1868); "Hand List of some Cognate Words in English, Latin, and Greek" (1871); "Questions for Examination in English Literature" (1873); "The Gospels of St. Mark and St. Luke, in Anglo-Saxon and Northumberland Versions synoptically arranged, with Collations exhibiting all the Readings of all the Manuscripts" (2 vols., 1875); and "Plutarch-Shakespeare," biographies (vol. i., 1875).

**SKELETON** (Gr., a dried body, from σκέλλειν, to desiccate), the bony and cartilaginous framework of animals, and the ligneous structure of the leaves of plants. In the higher animals the skeleton is internal (endo-skeleton); in many of the lower it is external (exo-skeleton). When the bones are joined by natural ligaments, they form a natural skeleton; when they are joined by wires and straps, the skeleton is said to be artificial. The study of the skeletons of different animals belongs to the subject of comparative anatomy; the human skeleton only will be described here. Bones may be classified as long, round, flat, and short. (See Bone.) The human skeleton consists of 208 bones, exclusive of the teeth, which are in reality parts of the digestive apparatus, and are developed from the mucous membrane. For convenience the skeleton may be divided into four regions: 1, the skull; 2, the trunk; 3, the upper extremities; 4, the lower extremities. The skull contains 30 bones, in three divisions, cranium, ears, and face. There are 8 cranial bones, viz.: 1 frontal, 2 parietal, 2 temporal, 1 occipital, 1 sphenoid, and 1 ethmoid. The frontal bone forms the forehead, upper part of the eye sockets, and front part of the floor of the cranial cavity. Just above the inner angles of the eyebrows are two marked prominences called the superciliary ridges, at which points the two tables of the bone separate considerably, enclosing cavities called the frontal sinuses which communicate with the nasal passages. The parietal bones, occupying the upper part and sides of the skull, are separated from each other by the sagittal suture, and from the frontal bone by the coronal suture. A curved ridge traverses both frontal and parietal bones at each side, which marks the origin of the fibres of the temporal muscle, lying in a depression behind and below the ridge, called the temporal fossæ. The temporal bones, situated at the sides and base of the skull, consist each of three portions: an upright or squamous portion, a posterior or mastoid portion, and an internal or petrous portion. The upright portion articulates with the parietal bone by the squamous suture. The mastoid portion has a projection, felt behind the ear, called the mastoid process, which has a cellular structure, communicating with the middle ear or tympanum; the cells are not developed till after puberty. The petrous (hard, stony) portion is in the form of a triangular pyramid, and lies upon one of its sides in the base of the skull, its apex pointing forward and inward. One of the openings into it, the internal auditory canal, transmits the auditory and facial nerves, and it also contains the tympanum. The temporal bones are pierced externally by the external auditory canal, which transmits the sonorous pulsations to the membrane of the tympanum. The under surface of the bone articulates with the lower jaw bone to form the joint. Just in front of this, and a little above, a process called the zygomatic springs forward to meet another of the same name from the cheek bone, forming a horizontal arch, the zygomatic, under which the tendon of the temporal muscle passes. The occipital bone consists of an upright and a basilar portion; the latter contains a large orifice, the foramen magnum, through which the brain connects with the spinal cord. On each side of the foramen magnum there is a condyle having an articular surface which rests upon a corresponding condyle of the atlas, the upper bone of the vertebral column. The basilar portion articulates in front with the body of the sphenoid bone, fig. 4, which in turn articulates with the ethmoid, fig. 5, the latter being situated at the root of the nose and held in position by the frontal and several bones of the face. There are 8 ear bones, 4 in each ear, situated in the tympanum; they are described in the article Ear. The 14 bones of the face are 2 nasal, 2 upper jaw or superior maxillary, 2 lachrymal, 2 cheek or malar bones, 2 palate bones, 2 inferior turbinated (in the nose), 1 vomer (septum of the nose), and 1 lower jaw, or inferior maxillary bone. (See illustrations.) Each upper jaw bone contains a large cavity called the maxillary antrum, which communi-

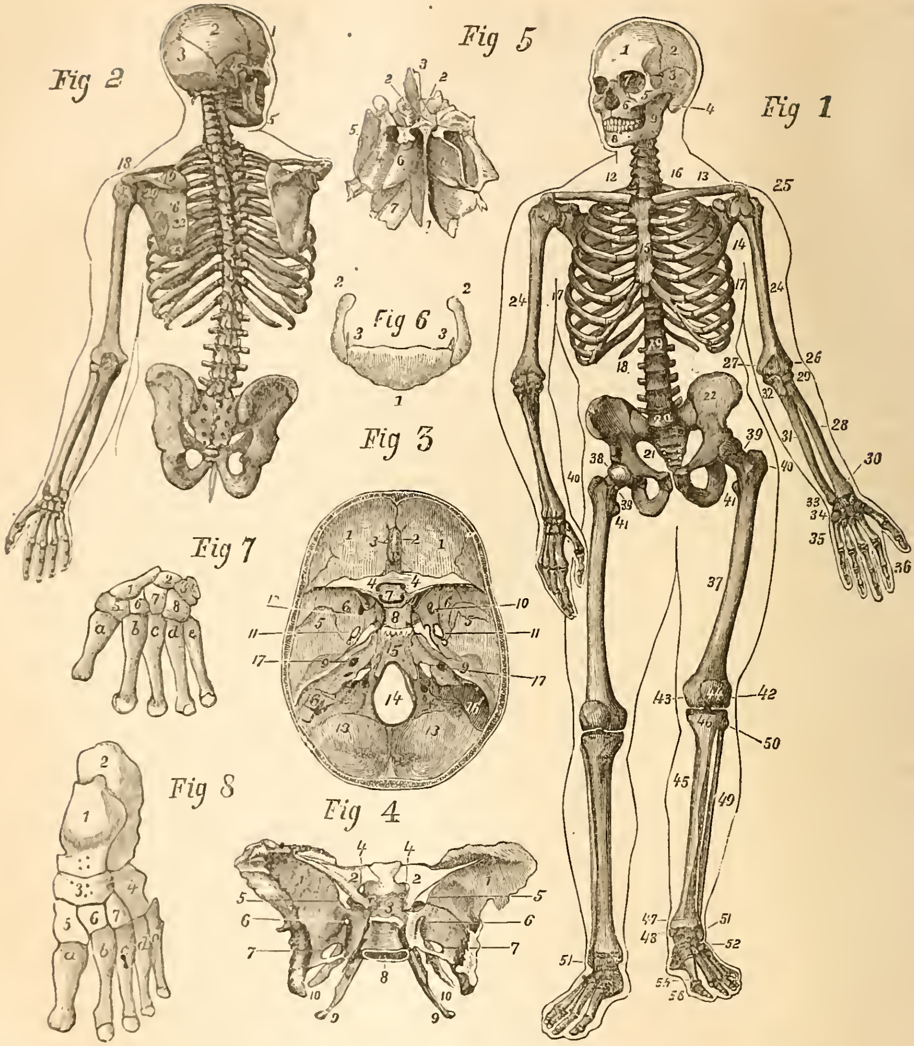



FIG. 1.—Front View of Skeleton. 1. Frontal bone. 2. Parietal. 3. Temporal; 4, its mastoid process. 5. Malar or cheek bone. 6. Upper maxillary. 7. Orbit of the eye. 8. Lower maxillary; 9, its ramus. 12. The cervical vertebræ. 13. Clavicle. 14. Scapula. 15. Sternum. 16. First rib. 17. Seventh rib. 18. Twelfth rib. 19. First lumbar vertebra. 20. Last lumbar vertebra. 21. Sacrum. 22. Ilium. (See PELVIS.) 24. Humerus; 25, its head; 26, its outer condyle; 27, its inner condyle. 28. Radius; 29, its head; 30, its lower extremity. 31. Ulna; 32, its head; 33, its lower extremity. 34. Carpus or wrist. 35. Metacarpus. 36. Phalanges. 37. Femur or thigh bone; 38, its head; 39, its neck; 40, its greater trochanter; 41, its lesser trochanter; 42, its outer condyle; 43, its inner condyle. 44. Patella or knee pan. 45. Tibia; 46, its head; 47, its lower extremity; 48, inner malleolus. 49. Fibula; 50, its head; 51, its lower extremity, forming outer malleolus. 52. Tarsal bones (7). 55. Metatarsal bones (5). 56. Phalanges.

FIG. 2.—Back View of Skull, Trunk, and Left Arm. 1. Frontal bone. 2. Parietal. 3. Occipital. 4. Temporal. 5. Lower maxillary. 18. Head of scapula at junction of clavicle. 19. Supra-spinous fossa. 20. Infra-spinous fossa. 21. Anterior border. 22. Posterior border. 23. Inferior angle. 24. Olecranon process of ulna.

FIG. 3.—Floor of Skull. 1, 1. Orbital plate of frontal bone, forming most of anterior fossæ. 2. Cribriform plate of ethmoid bone. 3. Crista galli process. 4, 4. Lesser wings of sphenoid bone. 5, 5. Middle fossæ of base of cranium. 6, 6. Greater wings of sphenoid. 7. Olivary process. Immediately in front of this process there is a transverse furrow called the optic groove, in which lies the commissure or crossing of the optic nerves. This groove terminates in the optic foramina, 4, 4, fig. 4. (See BRAIN, vol. iii., pp. 193, 194.) 8. Sella turcica, upon which rests the pituitary gland. (See BRAIN, p. 191.) 9, 9. Petrous portion of temporal bone. 10, 10. Round foramina for superior maxillary nerve. 11, 11. Oval foramina for inferior maxillary nerve. Interior to these two holes is a large slit-like opening on each side, giving passage to the internal carotid artery and some important nerves. 13, 13. Posterior fossæ of the floor of cranium. 14. Foramen magnum, for the spinal cord. 15. Basilar process of occipital bone. 16, 16. Grooved channel for the lateral sinus. (See BRAIN, p. 188.) 17, 17. Internal auditory meatus, transmitting the auditory and facial nerves.

FIG. 4.—Sphenoid Bone, seen from above. 1, 1. Its greater wings. 2, 2. Its lesser wings. 3. Sella turcica. 4, 4. Foramina for the optic nerves. 5, 5. Sphenoidal fissures, for third, fourth, sixth, and part of fifth pairs of cranial nerves. 6, 6. Round foramina. 7, 7. Oval foramina. 8. Part of basilar process of occipital bone. 9, 9. Internal pterygoid plates, terminating in muscular or hook-like processes, over which pass the tendons of the tensor muscles of the palate. 10, 10 External pterygoid plates.

FIG. 5.—Ethmoid Bone, seen from behind. 1. Central lamella. 2. Cribriform plate. 3. Crista galli. 5, 6, 7. Lateral mass of left side.
FIG. 6.—Hyoid or Tongue Bone, seen in front. 1. Body. 2, 2. Greater cornua. 3, 3. Lesser cornua.
FIG. 7.—Palmar Surface of Right Carpus and Metacarpus. 1. Scaphoid bone. 2. Lunar. 3. Cuneiform. 4. Pisiform. 5. Trapezium. 6. Trapezoid. 7. Magnum. 8. Unciform. *a, b, c, d, e.* The five metacarpal bones.
FIG. 8.—Tarsus and Metatarsus, forming Instep. 1. Astragalus. 2. Os calcis. 3. Boat-shaped or scaphoid bone. 4. Cuboid. 5. Internal cuneiform. 6. Middle cuneiform. 7. External cuneiform. *a, b, c, d, e.* The five metatarsal bones.

cates with the nasal passage. The lachrymal bones are small oval plates situated at the inner angles of the orbits of the eyes. The palate bones are situated at the posterior part of the nasal passages, and enter into the formation of the roof of the mouth or palate and the back part of the floor of the orbits of the eyes. The lower jaw bone consists of a horizontal semicircular portion, having an alveolar process into which the lower teeth are set, and of a perpendicular portion, the ramus, divided into two branches, one of which terminates in the condyle to form the joint, and the other is the coronoid process, into which are inserted the fibres of the temporal muscle and a portion of those of the masseter, the two principal muscles of the jaw. The floor of the skull is divided into anterior, middle, and posterior fossæ, the two first lodging the anterior and middle lobes of the cerebrum, and the posterior fossæ lodging the cerebellum. (See BRAIN.) The bones of the trunk are 54 in number, viz.: the 24 bones called vertebræ, constituting, with the sacrum upon which they rest, the spinal column, 24 ribs, 4 pelvic bones, 1 sternum or breast bone, and 1 tongue bone. The two hip bones are naturally classified with the lower extremities, but as they are joined to the sacrum by immovable sutures, and form with it an important piece of animal mechanism, the pelvis, they are here included in the bones of the trunk. (See PELVIS.) The spinal or vertebral column, or backbone, forms the axis of the trunk, supporting it and the skull. All of the vertebræ but one have their principal features in common; *i. e.*, they have a body, a spinous process, a spinal foramen for transmitting the spinal cord, and four articular processes, two superior and two inferior for articulating with each other. The spinous processes which project posteriorly together form the "spine," which marks the course of the spinal column. The uppermost vertebra, called the atlas, has no body, but its place is occupied by a tooth-like process of the bone next below, called the axis, around which the atlas turns. There are 7 cervical, 12 dorsal, and 5 lumbar vertebræ. The seventh cervical is peculiar from having a longer and more prominent spinous process than the others, which may be felt at the base of the neck. Between the bodies of the vertebræ are placed the elastic intervertebral cartilages, which permit flexion of the spinal column and prevent concussion of the spinal cord in walking and leaping. The ribs, 24 in number, are long flat bones of a semicircular form, and have an oblique position, their posterior extremities being higher than their anterior. The middle part of the curve is also depressed, so that the contraction of the respiratory muscles expands the cavity of the chest. There are 7 true and 5 false ribs on each side, the true ribs articulating with the sternum, while the false ribs lap on to each other, except the last two, which are free, and are called floating ribs. The sternum is a kind of breastplate, composed of three pieces, to which the collar bones and the ribs are attached. The tongue bone supports the root of the tongue and gives attachment to muscles for moving it. The upper extremities contain 64 bones, 32 on each side, in six divisions: 1, the shoulder; 2, the arm; 3, the forearm; 4, the wrist or carpus; 5, the palm or metacarpus; 6, the fingers or phalanges. The shoulder contains two bones, the scapula and clavicle. The scapula is a flat triangular bone situated at the upper and back part of the chest on each side. It is traversed on its posterior surface by a spine which terminates in the acromion process, the prominent point of the shoulder. Below the acromion process is the head of the scapula, containing a shallow cup called the glenoid cavity, which receives the head of the arm bone or humerus. The outer extremity of the collar bone or clavicle (Lat. *clavis*, a key) articulates with the acromion process, forming a kind of brace. The scapula is held to the trunk by powerful muscles, which allow of sufficient motion to give a variety of positions to the shoulder joint. The arm contains one bone, the humerus, the lower end of which by its expanded articular surface forms with the two bones of the forearm, the radius and ulna, the elbow joint. The wrist or carpus contains 8 bones (see fig. 6), the palm or metacarpus 5, and the fingers or phalanges 14, the first and second phalanx containing 5 each and the third 4. The apparatus of the forearm is a marvel of animal mechanism. The upper extremity of the ulna forms with the articular surface of the humerus a firm hinge joint, but the head of the radius forms with it a rotatory joint by which pronation and supination of the forearm and hand are effected with grace and facility. The lower extremities contain 60 bones, 30 in each limb, in six divisions: 1, the thigh bone or femur; 2, the knee pan or patella; 3, the two bones of the leg, the tibia and fibula; 4, the 7 bones of the ankle or tarsus; 5, the 5 bones of the metatarsus; and 6, the 14 bones of the toes or phalanges. The femur is the longest, largest, and strongest bone in the skeleton. Its upper extremity contains the head, which fits into the socket of the hip bone, and the neck, which joins the shaft of the bone at an angle of nearly 45°, the union being marked by two strong

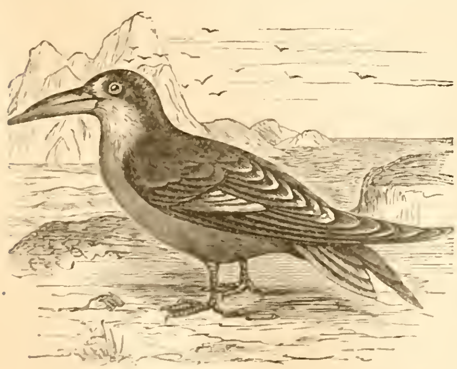
processes called the greater and lesser trochanters, to which are attached strong muscles, the chief office of which is to rotate the thigh, and also to move it outward and inward. Its lower extremity is expanded like that of the humerus, and articulates with the head of the tibia, the principal bone of the leg. The tibia articulates at its lower extremity with the astragalus, the bone occupying the summit of the arch of the foot, and the latter rests upon the calcis or heel bone, into which the tendo Achillis, the tendon of the strong extensor muscles of the calf, is inserted.

**SKELTON, John**, an English poet, born probably in Norfolk about 1460, died in Westminster, June 21, 1529. He graduated at Cambridge, entered holy orders, was tutor to the duke of York, afterward Henry VIII., became rector of Diss and curate of Trompington in 1504, and was appointed *orator regius* to Henry VIII. Anthony à Wood deemed him "fitter for the stage than for the pew or pulpit." He concealed the fact of his marriage, and was accused of keeping a concubine, and suspended by the bishop of Norwich. Among his writings are the drama "Magnyfycence," "The Bowge of Courte," "Collyn Clout," and a dirge on "Phyllyp Sparowe." The best edition of his works is by the Rev. Alexander Dyce, with an account of his life (2 vols., London, 1843).

**SKERRYVORE.** See Lighthouse, vol. x., p. 460.

**SKIDDAW**, a mountain near the centre of Cumberland, England, 3,022 ft. in height. It has the lake of Bassenthwaite Water on its west. Though there are some mountains in the same county of greater elevation, Skiddaw is the most imposing, as it stands so as to be seen at one view from the base to the summit.

**SKIMMER** (*rhynchops*, Linn.), a genus of web-footed birds of the gull family, and subfamily *rhynchopsinæ*. The bill is of singular shape, broad at the base, from which it is suddenly

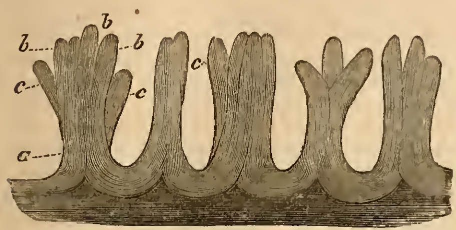


Black Skimmer (Rhynchops nigra).

compressed laterally to the end; the upper mandible is considerably the shorter, curving gradually to the tip, which is pointed and grooved underneath; the lower mandible is straight and truncated, more compressed, with a sharp cutting edge received into the groove of the upper; nostrils basal; wings very long and narrow, with the first quill the longest; tail moderate and forked; tarsi longer than middle toe; feet very small, toes short with indented web, hind toe elevated, and claws curved and sharp. Three or four species are described; they are most abundant in the tropics, where they frequent quiet bays and inlets; they feed chiefly at night on fish and crustaceans, which they catch as they skim along close to the water, dipping the under mandible beneath the surface and closing the upper suddenly upon it when prey is encountered; the flight is swift, graceful, and undulating, and the gait awkward; they rarely if ever swim or rest upon the water. The best known species is the black skimmer (*R. nigra*, Linn.), found on the Atlantic and gulf coasts of North America from New Jersey to Texas, on the E. coast of South America as far as the tropic of Capricorn, and, according to Lesson, on the W. coast. The length is about 19 in. and the alar extent 48 in.; the general color above is deep brownish black; the front to the eyes, throat, and under parts white; inner tips of four inner primaries white, and secondaries broadly tipped with the same; the central tail feathers dark brown, the others mostly white; the bill carmine for the basal half, thence black to the end, the upper mandible about $3\frac{1}{2}$ in. and the lower $4\frac{1}{2}$; tarsi and feet red, and iris hazel; the female is smaller. They are nocturnal, resting by day on the sand bars, in large flocks. The nest is a slight hollow in the sand, and the eggs are usually three, $1\frac{3}{4}$ by $1\frac{3}{8}$ in., white with large black or dark patches; the female sits only at night or in wet and cold weather; the young closely resemble in color the sand upon which the nest is made; they migrate to the south when the young are able to fly; their eggs are as good as those of the gulls. This species is sometimes called razor-billed shearwater, and scissors-bill. Other species are found on the W. coast of Africa.

**SKIN**, the external covering of the animal body, protecting the internal parts from external violence, and adapting itself by its elasticity to the various movements and changes of position; it also acts as the organ of touch, and as an excretory and absorbing surface. In the human skin, which may be taken as the type of that of the higher animals, the deepest portion is the *corium*, *dermis*, or *cutis vera*, as distinguished from the deciduous cuticle which overlies it, described under Epidermis. This true skin is dense and tough, somewhat elastic, composed of fibres interlaced in all directions, in whose interstices are masses of fat; the whole rests upon a layer of subcutaneous areolar tissue; within and below it are the sudoriparous or sweat glands (see Perspiration), the hair follicles (see Hair), and the sebaceous glands. From its upper surface rise the sensitive papillæ, which are minute conical elevations, most numerous on the palmar surface of

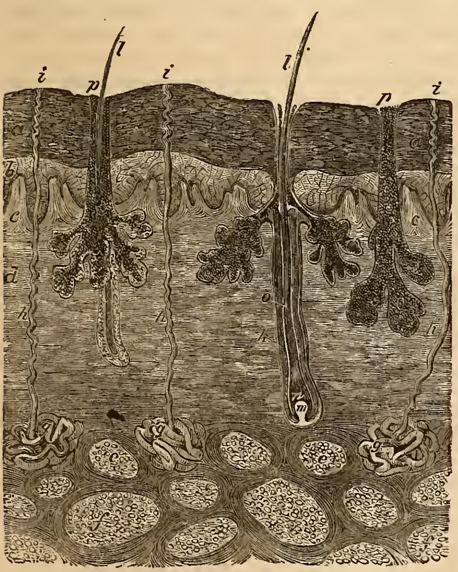
the hands and fingers, feet and toes, where they are arranged in double rows in parallel curved lines; the average length of the papillæ, including the height of the ridge upon which




Compound Papillæ of the Skin from the surface of the Hand, showing double, triple, and quadruple divisions.

*a.* Base of a compound papilla. *b, b, b.* Its upper extremities. *c, c, c.* Points of other papillæ, the base of which is not visible.

they are placed, is about $\frac{1}{100}$ of an inch, and the diameter at the base $\frac{1}{250}$; they are abundantly supplied with blood, which explains their erectile turgescence under stimuli; they adhere more or less firmly to the cuticle. The sebaceous or oil glands of the skin are formed on the same plan as the sudoriparous, and can



Vertical Section of the Skin, magnified.

*a.* Epidermis. *b.* Inferior layer of epidermis, or rete Malpighianum. *c.* Papillæ of the skin. *d.* Corium, or dermis. *e, f.* Lobules of adipose tissue. *g.* Perspiratory glands. *h.* Ducts of the perspiratory glands. *i.* Their external orifices. *k.* Hair follicle. *l.* Hairs projecting from the skin. *m.* Hair papilla. *n.* Hair bulb. *o.* Shaft of hair in the hair follicle. *p.* Openings of the sebaceous glands.

often be distinguished from them only by the nature of their oily secreted product; they are distributed over the whole surface of the body, being least abundant where the perspiratory glandulæ are most numerous, and *vice versa;* they are absent on the palms and soles, but abundant on the face and scalp; they vary considerably in size, but the tubes are generally wider and straighter than those of the sweat glands; the structure is sometimes complicated. In the parts of the skin covered with hair, there is usually a pair of sebaceous ducts opening into the follicle of each hair. The object of their secretion is doubtless to prevent drying and cracking of the hair by the sun and air; this secretion is most abundant in tropical nations, and in some dark races has a characteristic odor, as in the case of the negro; its protective action in the tropics is often assisted by vegetable oils applied externally. The Meibomian glands on the edges of the eyelids are a double row of sebaceous follicles set along a straight duct; they secrete an oily matter for the lubrication of these parts, which in diseased conditions frequently sticks them together. Another modification of sebaceous glands is to be found in the external ear passage, where is secreted the *cerumen* or waxy matter; they consist here of long, highly contorted tubes, well supplied with blood vessels. The color of the skin depends on pigment cells mixed with the inferior epidermic ones, in what is called the *rete mucosum*, or mucous layer, and considered by Flourens and other authors as a distinct membrane; all the hues of the races of man depend on the relative abundance of these cells and the tint of the contained pigment. The folds of the skin are for the most part produced by the contractions of the superficial muscles. The skin is pierced at the eyes, ears, nostrils, mouth, rectum, and genito-urinary opening; it is continuous internally with the mucous membrane, consisting of the same elements modified according to the variety of functions to be performed; it is very vascular, and freely supplied with nerves and lymphatics. The skin is the seat of the sense of touch in man, though in most animals hairs, scales, bony or horny plates and envelopes, and shells, render it nearly insensible to external influences, this sense in them being confined to particular portions or projecting organs; even in man the sensibility varies much in different parts, being most acute at the ends of the fingers and on the lips, and dullest on the back and limbs. Aëration of the blood takes place to a certain extent through the skin, and in some naked-skinned fishes and batrachians this is a very important part of the respiratory process. It has been shown by experiment that in a frog, after the removal of the lungs, one fourth of a cubic inch of carbonic acid is exhaled from the skin in eight hours; in man the amount of this gas given off by the skin varies from $\frac{1}{60}$ to $\frac{1}{30}$ of that exhaled from the lungs; where the lungs perform their office imperfectly, the temperature of the skin is often high; in all febrile diseases it should be kept moist. The absorbent powers of the skin are noticed under ABSORPTION.

**SKIN, Diseases of the.** See p. 880.

**SKINK,** the common name of the *scincidæ*, a family of lepidosaurian, slender-tongued lizards, with elongated cylindrical body, covered above and below by imbricated fish-like scales, arranged in quincunx and held in membranous sacs; they have no lateral folds. The family, by such forms as the seps and orvet, constitutes a connecting link between the saurians and ophidians. The head is covered with large angular plates, joined by their borders; the neck is of the same size as the chest; the tongue free, without sheath, slightly notched in front, with the surface mostly covered with papillæ; the scales are smooth. They creep with a lateral sinuous motion like serpents; they have no crests nor fringes on the neck, back, sides, or tail, the last being conical, and generally long and without spines; the feet (absent in some) are short and clumsy, with well developed digits and claws. The jaws are short and united at the symphysis, so that the opening of the mouth is always the same; the teeth are sharp and slender, suited for seizing insects and worms; in the snake-like forms only one lung is largely developed; the ears are exposed. They are generally small, and live in holes and under stones in dry sandy places; they are usually of an earthy gray color. They inhabit the torrid zone and the driest portions of temperate regions. Duméril makes three great divisions according to the differences in the covering of the eyes: 1, *saurophthalmes*, with lizard-like eyes, protected by two lids moving vertically; 2, *ophiophthalmes*, with a rudimentary lid, as in serpents; and 3, *typhlophthalmes*, in which the eyes are concealed under the skin. Most of the more than 30 genera, comprising more than 100 species, belong to the first division, the only one that need be treated here; some of them have four limbs, others two, others none. Dr. Gray divides them into *scincinæ*, with smooth scales, and *tropidophorinæ*, with

Common Skink (Scincus officinalis).

keeled scales.—In the genus *scincus* (Fitz.) the snout is wedge-shaped, the upper jaw the longer, the teeth simple, conical, and obtuse, with a row on the palate; the limbs are four, with five nearly equal digits, flattened, and with serrated borders; the tail is conical and pointed. The common skink (*S. officinalis*, Laur.) is 8 or 9 in. long, with stout body, short thick limbs, and a proportionally short tail, very thick at the base; the eyes are small, high up and far back. The colors vary considerably, from silvery yellow to brownish, with seven or eight black transverse bands. It is a native of Egypt, Nubia, Arabia, and N. and W. Africa.—There are several American species of this family, most of which are popularly called "galliwasps," one of the best known of which belongs to the genus *diploglossus* (Wieg.), characterized by a tongue with scaly papillæ in front and filiform behind, toothless palate, flat head, obtuse muzzle, and flattened body; the feet have five unequal toes, compressed, without lateral edgings, and with tuberculose palms and soles; the scales are striated, and ridged in the middle; the tail is rounded, long and pointed, with a very large anal operculum. The great galliwasp (*D. occiduus*, Wieg.) is about 21 in. long, of which the tail is one half; it is one of the largest of the skinks. The color above is generally light brown, with a dozen or more transverse bands, sometimes darker and sometimes lighter, and yellowish white below with brownish tints. It is found in Jamaica, where it is very much dreaded, though it is perfectly harmless; it forms the type of Gray's genus *celestus*. The five-lined skink (*euprepes quinquelineatus*, Wagl.) is 10 to 11 in. long, the head pale red with six obscure white lines, the two internal confluent at the back part; the body above is olive brown, with five pale white longitudinal lines and a black lateral band; the tail brown, tinged with blue, and the lower surface white. There are no teeth on the palate, otherwise the characters are as in the last genus. It lives in the stumps of old trees in thick woods, not far from the ground, and is found from lat. 35° N. to the gulf of Mexico and west to the Mississippi river.

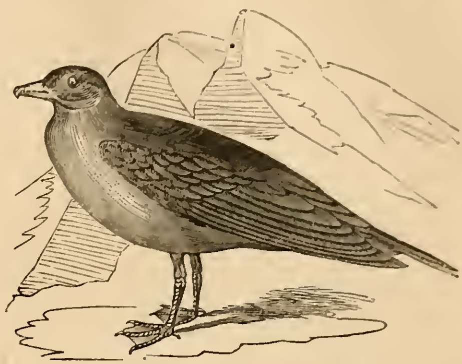
**SKINNER, Thomas Harvey,** an American clergyman, born at Harvey's Neck, N. C., March 7, 1791, died in New York, Feb. 1, 1871. He graduated at Princeton college in 1809, was licensed to preach in December, 1812, and was a pastor in Philadelphia from 1813 to 1832, when he became professor of sacred rhetoric in Andover theological seminary. In 1835 he became pastor of the Mercer street Presbyterian church, New York, and in 1848 professor of sacred rhetoric and pastoral theology in the Union theological seminary. He published "Religion of the Bible" (1839); "Aids in Preaching and Hearing" (1839); "Hints to Christians" (1841); "Thoughts on Evangelizing the World;" "Religious Life of Francis Markoe;" "Vinet's Pastoral Theology," and "Vinet's Homiletics," translated from the French (1854); and "Discussions in Theology" (1868).

**SKIPJACK.** See Bluefish, and Bonito.

**SKOBELEFF, Mikhail Dimitriyevitch.** See p. 890.

**SKRZYNECKI, Jan Boncza,** a Polish soldier, born in Galicia in February, 1786, died in Cracow, Jan. 12, 1860. His military career began in 1806, and he distinguished himself in the Napoleonic wars, and after the Polish revolution of 1830 as brigadier general, especially at Dobre, Wawer, and Grochów (February and March, 1831). He then succeeded Radziwill as commander-in-chief; but waiting in vain for assistance from foreign powers, he failed to follow up his great advantages, and lost the battle of Ostrolenka, May 26. On Aug. 10 he was deposed, and after the fall of Warsaw (Sept. 8) he fled to Austria and next to Belgium. In the latter country he was appointed to a high command in the army, which however, owing to the protests of the eastern powers and the peace of 1839 with Holland, was of short duration. He remained in Brussels until shortly before his death, when he was permitted to return to Poland.

**SKUA,** the common name of the web-footed birds of the gull family, subfamily *lestridinæ*, and genus *stercorarius* (Briss.). The bill is strong, the basal half with a membranous or corneous cere distinct from the tip, the nostrils opening under it in advance of the middle of the bill; the tip is abruptly and strongly curved; the wings very long, the first quill the longest; the tail wedge-shaped, the two central feathers projecting; tarsi strong, with prominent scales; claws sharp and curved, and feet fully webbed, with the hind toe short and but little elevated; body full and stout. They inhabit the high latitudes of both the northern and southern hemispheres; they chase gulls and other marine birds, even the albatross, forcing them to disgorge a part of their food, and are hence called jagers or yagers; they feed also on the carcasses of cetaceans, the eggs and young of sea birds, and the smaller petrels. Their flight is elevated, rapid, long sustained, and generally in circles, as in birds of prey, which they represent among the *natatores;* the nests are made in company, of coarse grass, and are placed on rocks or sand, or in desolate heaths; the eggs are one or two. —The common skua (*S. catarractes*, Temm.), the largest species, is about 2 ft. long, with an alar extent of about 4½ ft.; the bill is 2½ in.; the color above is dark brown, the feathers tipped with gray; wings chocolate brown with the shafts and basal parts white; tail dark brown, white at the base; lower parts dark grayish brown; legs, feet, and bill black, the latter with a tinge of bluish; the central tail feathers project only an inch beyond the others. The favorite haunts of this species are the seas of northern Europe, especially about the Orkney and Shetland islands, where great numbers are killed for their feathers; it has been obtained on the California coast, and either this or a nearly allied species occurs about Cape Horn, the cape of Good Hope, and in the antarctic seas. The arctic skua (*S.* [*lestris*] *parasiticus*, Temm.) is 21 in. long and 44 in. in extent of wings; the central tail feathers extend about 3 in. beyond the others, and are pointed at the end. This species breeds in arctic America, coming down as



Common Skua (Stercorarius catarractes).

far as New York in summer and to the gulf of Mexico in winter; it breeds also in the Orkney and Shetland islands.

**SKULL.** See COMPARATIVE ANATOMY, and SKELETON.

**SKULLCAP,** the common name for plants of the labiate family of the genus *scutellaria*, the botanical name being derived from Lat. *scutella*, a dish, as the fruiting calyx has an appendage which closes it; this appendage has also suggested the popular name skullcap. The skullcaps are perennial herbs, destitute of the aromatic qualities usually found in the order; they are widely distributed over the temperate and subtropical countries, and some of the Mexican and South American species are sometimes met with as greenhouse plants. Eight or ten species are found in our northern states. The common skullcap (*S. galericulata*), common also in Europe, is very frequent in wet and shady places, and is quite showy; it has had a medicinal reputation, as has a still more common species, *S. lateriflora*, which under the name of mad-dog skullcap was some years ago used as a pretended remedy for hydrophobia. The plants are of interest to the botanist, but of no medicinal value.

Common Skullcap (Scutellaria galericulata).

**SKUNK,** an American carnivorous mammal of the weasel family, badger subfamily, and genus *mephitis* (Cuv.). It may be distinguished from its congeners by a more slender and elongated body, pointed nose, feet adapted for digging, with the anterior claws the longest and the soles usually naked, and a long bushy tail. The cheek teeth are $\frac{4-4}{5-5}$, the upper posterior being very large and nearly square; the head is small, with a projecting naked nose, small and piercing eyes, and short and rounded ears; the feet are short, with five closely united toes; the palms naked and the soles mostly so; they are essentially plantigrade, and walk with the back much arched and the tail erect; they are nocturnal, and feed on animal substances. Though weak, timid, and slow in their motions, they are effectually armed against the most ferocious enemies in an acrid and exceedingly offensive fluid secreted by glands whose ducts open near the anus; these glands are surrounded by a thick muscular covering, the contractions of which are sufficient to eject the fluid to a distance of 14 ft.—The common skunk (*M. mephitica*, Shaw; *M. chinga*, Tiedm.) is from 16½ to 20 in. long, the tail being 13 or 14 in. additional; the prevailing color is black, with a narrow line on the forehead, broad triangular patch on nape continuous with a narrow line on each side of the back, and tail tuft, white; the variation is considerable, the white markings being wider in some specimens, and in others wanting; the posterior third of the soles is hairy. When about to use its natural means of defence, it raises its tail over the back, and ejects the secretion in two thread-like streams with great force and accuracy; it can also diffuse it in a fine spray on near objects; it is almost impossible to remove the odor from clothes impregnated with it, and a dog which has been touched by it is a nuisance for weeks; it is said to be phosphorescent at night. It is a very cleanly animal, and never allows its own

Common Skunk (Mephitis mephitica).

fur to be soiled with its secretion. It sometimes commits havoc among hens, chickens, and eggs, but is far less injurious than the mink and weasels, and from its clumsiness is more easily detected; it feeds on small quadrupeds and birds, reptiles, insects, nuts, and fruits. It has from six to nine young at a time, and would prove exceedingly annoying were not great numbers killed by dogs and carnivorous mammals and birds, and caught in traps at the mouths of their burrows, which are generally near the surface, in level ground, and 6 to 8 ft. in extent. They remain in their burrows in the northern states from December to the middle of February, laying up no winter stores, but retiring in a very fat condition, and remaining dull and inactive, though not properly hibernating. This species is abundant in the northern and middle states, and found from lat. 57° N. to Florida and Louisiana, and west to the Mississippi river. Its flesh is white and fat, and if properly skinned in no way tainted by its secretion; it is highly esteemed by the Indians, and is eaten by the whites in various parts of the country; the oil, nearly pure oleine, is excellent for leather, but is of no special use in medicine; the fur is rather coarse, but is sometimes used for common purposes, and of late years thousands of skins have been annually carried to Europe, where they make their appearance in various disguises. The secretion has been successfully employed in some forms of asthma, in the dose of a drop three times a day, though it so taints the patient's excretions that the remedy is generally considered worse than the disease; it has also been used as a powerful antispasmodic in asthma, hysteria, and other nervous disorders, applied to the nostrils.—There are several other species in the United States, especially in Texas and California. In an article in the "American Journal of Science" for May, 1874, Mr. Hovey says that this animal is very dangerous in the western states. It is often affected by a disease which renders its saliva so poisonous that its bite is more to be feared than that of the rattlesnake. He gives many instances in which persons sleeping on the ground have been bitten, generally with fatal, and always with dangerous consequences.

**SKUNK CABBAGE,** a plant the peculiar odor and the large clusters of luxuriant leaves of which readily suggested the common name. Botanically it has received the names *pothos*, *ictodes*, *dracontium*, and others, but botanists have finally settled upon *symplocarpus* (Gr. *συμπλοκή*, connection, and *καρπός*, fruit, in reference to the manner in which the ovaries form a connected or compound fruit). In all the different genera in which it has been placed, it retained the descriptive specific name *fœtidus*. It belongs to the arum family, which is well known through its handsome exotic representative *Richardia*, the calla lily, or lily of the Nile. The skunk cabbage is one of our very earliest spring flowers, and appears in wet places from New England to North Carolina; the flowers come long before the leaves in the latitude of New York, often as early as February, and they are very abundant in March and

April. The plant is an endogen, and its perfect flowers have four petals each, with as many opposite stamens, and a simple pistil with a one-ovuled ovary, which has a four-angled style.

Skunk Cabbage (Symplocarpus fœtidus).

These flowers are crowded in a dense globular cluster upon a short stem or spadix, and the cluster is surrounded by a peculiar, shell-formed hood or spathe, with an incurved point and of the shape shown in the engraving; this hood is sometimes of a dark lurid purple color, but is more frequently striped and spotted with yellow and purple, and sometimes varied with blotches of green and red. The hoods may be found long before the leaves appear, as these seem to require warm weather for their luxuriant growth; but they grow very rapidly when they start, and are heart-shaped, on short petioles and 1 to 2 ft. long; they form large clusters, which disappear very suddenly after midsummer, the spathe around the flowers having decayed much earlier. The fruit is a large oval fleshy mass, consisting of the purplish and green, berry-like seeds immersed in the enlarged spadix. All parts of the plant have a strong and strikingly skunk-like odor, which has been likened to a combination of garlic and asafœtida; the seeds are odorless when whole, but very strong when bruised. The root has been used as a stimulant and expectorant, but it rapidly deteriorates when dried. The leaves are sometimes used to dress blisters to keep up the discharge.

**SKYE,** the largest island of the inner Hebrides, off the W. coast of Scotland, forming part of Inverness-shire, from the mainland of which it is separated by the narrow strait of Loch Alsh; area, 535 sq. m.; pop. in 1871, 17,330. The surface is mountainous. In the centre of the island the Cuchullin or Coolin hills and other summits rise to the height of 2,000 and 3,000 ft. above the sea. The shores, especially in the north, are very bold and picturesque, and are indented by many inlets or lochs. In the northeast are basaltic columns equal to those at Staffa, and caves, some of which abound with stalactites of great beauty. Soapstone, manganese, jet, and some coal are found, but none of them are productively worked. White and variegated marble is quarried. The climate is variable; on the higher portions the snow lies long, and when it melts there are heavy rains. The soil is poor and the productions scanty. The greater part of it is in pasture, and devoted to the rearing of cattle and sheep. Large plantations of trees have lately been made. Red deer and game are abundant. The well known Skye terrier is raised here. The fisheries, especially in the sounds between the island and the mainland, furnish employment and subsistence to a large proportion of the inhabitants. The manufacture of kelp, once extensive, is now nearly extinct; there are no other manufactures, and very little trade. The people are of Gaelic origin; they are peaceable and moral, but indolent and generally poor. The island contains many Danish antiquities. The greater part of the land belongs to Lord Macdonald and the Macleod family. Skye was the home of Flora Macdonald, who died here in 1790. The principal port is Portree, which has an excellent harbor.

**SKYLARK.** See Lark.

**SLANDER,** in law, defamatory words falsely and maliciously spoken, and injurious either in fact or in legal presumption. It is actionable slander: 1, to speak of one thus falsely and maliciously words importing his guiltiness of an offence involving moral turpitude or punishable by law; 2, to charge him with having such an infectious, or perhaps disgusting disease as, if known, would probably cause his exclusion from society; 3, to use in regard to one in office, or of a person in reference to his profession, trade, or business, such language as has a natural tendency to cause him damage or loss, either because the language implies the lack of some requisite qualification for the occupation or profession, or because it implies insolvency or some positive misconduct or dishonest practice in the business or calling; 4, to speak words which, though not naturally or presumptively productive of loss, have nevertheless caused actual damage to the person slandered. Of these four classes of slanderous words, the first, second, and third include those that are actionable *per se*, or of themselves; that is to say, if the plaintiff proves that the words were spoken, he recovers damages without proving any particular loss. An action lies for words of the fourth class only when the plaintiff can prove express and special damage.—Of the form of slander which imputes guiltiness of crime, it is to be observed that the immediate ground on which the law founds the action is that injury to the party's reputation and his consequent degradation in society which is the natural and immediate incident of criminal guilt.

The words must therefore suggest an offence which subjects the party to a criminal prosecution and to infamous punishment. If the penalty for an offence is merely pecuniary, it does not appear that an action will lie for charging it, even though in default of payment imprisonment should be prescribed by the statute, the imprisonment not being the primary and immediate punishment of the offence. But the words will be actionable in themselves in case the charge, if true, will make the party charged liable to an indictment for a crime involving moral turpitude or subjecting him to an infamous punishment. Thus, to charge forgery or counterfeiting, keeping a bawdy house, bribery at an election, and the soliciting one to commit murder, are all actionable slanders *per se*, for they suggest both moral turpitude and an indictable offence. For the same reason it is actionable *per se* not only to say that one has done enough to send him to the penitentiary, but to say that he has already been there. But to allege that one lives by imposture imputes indeed moral turpitude, but not an indictable offence, and is consequently not slanderous *per se*, or without proof of actual damage. Words alleging perjury are actionable of themselves. The language must of course either express or imply all that is essential to constitute the crime, to wit, a judicial proceeding, material testimony, and the other essential elements of perjury. A charge of false swearing which does not expressly or impliedly comprehend all these points is not slanderous. Theft is an indictable and infamous offence, and the false and malicious imputation of it is actionable without proof of damage. One may sometimes call another a thief, just as he calls him scoundrel, liar, or cheat, by way of general abuse, and without any intention of charging the crime of larceny to him. If the defendant can show this clearly, he may defeat the presumption which the law always makes of a slanderous quality and intent in the word. Where fornication is made punishable by statute, as in most of the states, it is slanderous *per se* to charge unchastity. It was not so at the common law, but the hardship, and indeed the absurdity of this rule, when the consequences to a woman are considered, are so manifest that it has quite generally been changed by statutes in the several states. Words charging disease are actionable only when they imply that the disease now exists.—The third class of slanderous words includes those imputations which affect one's official, professional, or business character. To be actionable of themselves, the words must immediately contemplate and touch these relations; for it is invariably held that where the words complained of, though calculated in every respect to cause the forfeiture of an office or the loss of the income of a profession or business, are nevertheless not in fact applied to the conduct of the plaintiff in his office or business, the action for slander fails. But words which necessarily, even if not in terms, refer to and affect one's business relations, may be held slanderous; as to say, for example, in reply to an inquiry about failures, "I understand there is trouble with the Smiths," or "B owes more money than he is worth, and is broken." So it is slanderous *per se* to say that a trader is insolvent, that X keeps none but rotten goods, that Y uses filthy water in making his beer, or that Z keeps false books, where keeping books is a necessary incident to the business. It is slander to charge an attorney or physician with general ignorance or unskilfulness in his profession; and words which of themselves allege ignorance or unskilfulness in a particular case may be actionable if they fairly imply general disqualification in these respects.—The fourth class includes those words for which an action lies if special damage be proved. Thus, to say of another that he is a knave, a blackleg, a liar, a cheat, or a scoundrel, is generally not actionable. If, however, the speaking of these or the like defamatory words has wrought the plaintiff particular pecuniary loss, he can recover damages.—In all cases in which an action for slander lies, an essential principle on which the action rests is that the speaking of words false in fact and injurious to the reputation of another is malicious. By malice in this place is to be understood, not that disposition of ill will, spite, or revenge which in common parlance the word implies, but that legal malice which is the presumption and conclusion of the law from the fact of the deliberate and unqualified statement of false and defamatory matter, without cause or justification. Where these elements coincide, the law implies the malice, and the slander is complete. It is the corollary of this conception of slander that a defendant cannot justify the speaking of the slanderous words by the plea that he merely repeated the language of another. Formerly, indeed, it was held, on the authority of an old case in Coke, that if the defendant, at the time of uttering the words complained of, named his informant and gave his precise language, so as to furnish the plaintiff with a good cause of action against him, these facts might be pleaded as presumptive proof that the defendant did not utter the slanderous words maliciously. But the latest English cases hold that the defendant's plea must go further, and must show in addition to the facts just mentioned that he believed the charge to be true, and repeated it with a justifiable intent and on a justifiable occasion. The American rule is at least equally strict, and until the legal presumption of malice is rebutted by showing a justifiable intent and justifiable occasion, the uttering or repeating of slanderous words is actionable. To refrain altogether from the repetition of such words is the only way to be entirely safe. The presumption of legal malice is defeated when the otherwise slanderous language is employed upon a just occasion, in the discharge of a duty or in the protection of an

interest. Such communications as these are said to be privileged, and the burden of showing express malice is thrown upon the plaintiff. In a leading case upon this subject in the supreme court of the United States, privileged communications were divided into four classes, viz.: 1, publications duly made in the ordinary mode of parliamentary proceedings; 2, words used in the course of legal or judicial proceedings; 3, anything said or written by a master in giving the character of a servant who has been in his employment; 4, words used by any one in good faith in the discharge of any public or private duty, legal or moral, or in the prosecution of his own rights or interests. With reference to the first of these classes, the exemption from liability for any words spoken in debate is expressly provided by the constitution of the United States, and is probably repeated in the declaration of rights in the constitution of every state in the Union. The exemption extends to everything said or done by a representative in the discharge of his office, whether in debate in open session of the house, or more privately out of the house in committee, or even during the ordinary adjournment of the sessions. On the same principle, namely, the public interest in the prompt, unembarrassed, and efficient administration of the laws, all language spoken in good faith in the course of legal proceedings before a competent jurisdiction, pertinent in any wise to the matter in question, enjoys perfect immunity. The benefit of the privilege is secured alike to the parties, the counsel, the witnesses, the judges, and the jury. As to statements made by masters in reference to the character of their servants, good faith will be presumed, and it is for the servant to negative the presumption. Malice will be implied if he shows the falsehood of the charge; and there may be a *prima facie* presumption of malice if a master volunteered the unfavorable statement respecting his discarded servant.—In a civil action for slander, the truth of the facts imputed may be pleaded by the defendant in justification. If the plea is maintained by proof, the action is defeated; for the principle is, that if the plaintiff is guilty of the whole matter charged to him, he has sustained no injury and has therefore no valid claim for damages. The amount of the damages lies almost entirely within the discretion of the jury. They may give punitory or vindictive damages in cases of wanton and unqualified malice; and even though the amount may seem excessive, yet the court will not generally set the verdict aside, unless it shall be plain that the jury was influenced by improper motives or was misled by some gross error.

**SLANG**, a burlesque or colloquial form of expression, the language of low humor, or the jargon of thieves and vagrants. Slang is probably as old as human speech. We find traces of it in many of the early writers, particularly the Greek and Roman dramatists; and the works of Aristophanes, Plautus, Terence, and Martial abound with words which the purists of their day would not have recognized. All modern European languages have their vulgar or slang dialects, and some of them more than one; and in several countries the thieves' jargon has been reduced to grammatical rules and has a literature of its own. The language used by the English criminal classes is called more properly cant, but slang and cant have borrowed so many terms from each other that it is almost impossible to distinguish them. It is equally difficult to draw the line between slang and pure language, for very many words, illegitimate in origin, have become classical by prescription. The word slang is supposed to be of gypsy origin, and to have been used as a synonyme of Romany or Bohemian, the Zingari or gypsy tongue. Gibberish was used in nearly the same sense. The gypsies probably entered England in the beginning of the 16th century. They came as conjurers and jugglers, professing the gifts of palmistry and second sight, and speaking a secret language. They met with favor among the lower classes, and speedily found many imitators, who adopted their habits and many words of their language, while the gypsies added to their own vocabulary numerous terms and phrases of English vagabondage. Thus between them was formed a kind of slang compromise, out of which eventually grew the conglomerate jargon called variously the canting language, peddlers' French, thieves' Latin, and St. Giles's Greek. The earliest collection of English cant words is contained in "A Caueat for commen Cvrsetors vulgarely called Vagabones," by Thomas Harman (4to, London, 1567). Harman fell into such disrepute with thieves and vagrants for his exposure of their secret tricks, words, and signs, that his name became the cant synonyme for a constable and the stocks. "The Belman of London, bringing to Light the most notorious Villanies now practised in the Kingdome," by Thomas Decker (4to, London, 1608), professes to give an account of the cant of thieves and vagabonds, and contains much curious information. The civil wars brought into common use many slang and cant terms, but it was reserved for the court of Charles II., in which coarse wit was the fashion, to bring slang to a perfection before unknown. Lords and ladies talked slang, and much of the literature of the time is filled with it. Butler's "Hudibras," according to a contemporary writer, was the chief entertainment of Charles II., who often quoted it. In the time of George III. and the regency, the current slang was known as "flash," and sometimes as the language of "gig." The most important of the early collections of slang and cant words, and that on which almost all later works have been founded, is Francis Grose's "Classical Dictionary of the Vulgar Tongue" (8vo, London, 1785), containing all the cant and slang of the earlier glossaries, and

all the vulgar, flash, and indecent terms of the author's time. It has been several times reprinted; the best edition is by Pierce Egan, with additions (8vo, 1823). A "Slang Dictionary" was published in London in 1860, and a revised edition of it in 1875. The earliest work on American vulgarisms is the Rev. Dr. John Witherspoon's "Essays on Americanisms, Perversions of Language in the United States, Cant Phrases," &c. (Philadelphia, 1801), originally published in a periodical called "The Druid" in 1761.—Slang, considered as the generic term for all illegitimate words and phrases, consists partly of words derived directly from thieves' cant and foreign languages, partly of old words with new adaptations, and partly of new words and expressions coined to meet new conditions. Many of the most common slang words were originally thieves' cant, and have been in use for centuries. Among these are "cove" or "covey," a boy or man; "darbies," handcuffs; "doxy," a strumpet, a tramp's female companion; "duds," clothes; "fence," a receiver of stolen goods; "glim," a light; "mug," the mouth or face; "nob," the head; "swag," booty or property; "tog," a coat; and "wipe," a pocket handkerchief. Of words derived from the gypsies are "bosh," nonsense; "cheese," anything good or genuine; "pal," a friend or accomplice; "rum," good (man or thing); and "snack," a share of plunder. Besides what English slang has drawn from the Celtic, Gaelic, Saxon, and Norman French, it derives many words from other European tongues, including the ancient Greek and Latin, and from several of the eastern languages, notably the various East Indian dialects, the Persian, and the Chinese. Among the words borrowed from the French are: "cahoot" (*cohorte*), to keep company; "spree" (*esprit*), a carousal; and "feele" (*fille*), a girl; from the Spanish: "savvey" (*sabe*), to know; "vamose" and "mosey" (*vamos*), to go; and "cavort" (*cavar*), to caper; from the German: "loafer" (*Läufer*), an idle fellow; "frow" (*Frau*), a wife; and "bower" (*Bauer*), used in right and left bower in cards; and from the Dutch: "boosey" (*buizen*), drunk; "logy" (*log*), dull, heavy; "boss" (*baas*), a master or head; and "landlubber" (*landlooper*), a vagabond. The East Indian tongues contribute "tiffin," breakfast or lunch; "dungaree," poor, motley; and "chit," a letter; and the Chinese, "chop," used in such expressions as "first chop," "second chop"; "kootoo" or "kotow," to cringe to, to flatter; and "pigeon," the Chinese pronunciation of business, used in the expression "pigeon English." The *lingua Franca*, or bastard Italian, spoken in the Mediterranean seaports, which is a barbarous compound of most of the languages used along the shores of that sea, has also contributed largely to English slang. Of old words invested with new meanings, some of the most common are: "bleed," to pay or lose money; "blow," to vaunt or boast; "bolt," to leave, to run away; "do," to cheat, as "to do one out of his money," &c. The verb "to go" furnishes numerous slang phrases, as "go it strong," "go back on," "go ahead," "go for one," "go through," "go by," "go the whole hog," "great go," "little go," "rum go," "pretty go," a "go" of liquor, &c.; and "let" almost as many, as "let slide," "let rip," "let up," "let on," "let out," "let in," "let drive," "let alone," "let the cat out," &c. Many of these, although properly slang, have acquired through constant use a right to a place in the language, and may be regarded as good "dialect" English. To this class also belong many of the words usually called Americanisms, which had their origin in this country and have a flavor of our institutions, such as "log-rolling," "wire-pulling," "axe-grinding," "pipe-laying," "filibustering," "mudsill," "mean white," "doughface," "jayhawker," "bushwhacker," "copperhead," "carpet-bagger," "shinplaster," "stamp," "greenback," "copper," "nickel," &c. The fashionable affectation too of using French words, with meanings which would not be recognized in Paris, as "on the *tapis*," "to *chaperon*," "*beau monde*," "*thé dansant*," may be relegated to this department of slang. America is responsible also for very many of the new words coined to meet new conditions, such as "caboodle," "calithumps," "contraptions," "highfalutin," "hunkydory," "shenanigan," "spondulicks," "skedaddle," "scalawag," and such corruptions as "slantindicular," "rambumptious," and "splendiferous." (See AMERICANISMS.) Every business, vocation, and profession has its slang, and every notable civil event and political convulsion furnishes new phrases and words, most of which are ephemeral. The press and the theatre are prolific coiners, and the university, the army, the exchange (see STOCK EXCHANGE), politics, fashion, the prize ring (see PUGILISM), and the turf are all responsible for a large share of the current slang of the day. The sea too is no less profuse in illegitimate expressions than the land, and sailors' slang is proverbial.—In France the jargon of the thieves and vagrants, which is called *argot*, is a comprehensive language, with a grammar and literature of its own. Argot has been traced as far back as the 14th century according to some authors, but others believe that it originated with the gypsies, who appeared in Paris in the first half of the 15th century. One of the earliest works on it is *Le jargon, ou langage de l'argot réformé*, &c. (Troyes, 1660). In 1827 a dictionary of argot was published in Paris; but the prosperity of argot literature dates rather from the publication in 1837 of Vidocq's work on thieves, containing the argot dictionary, which he began in 1819. Since then many other works have appeared, of which one of the most valuable is Michel's *Études de philologie comparée sur l'argot*, &c. (Paris, 1856). Argot has found a conspicuous place in modern

French novels, especially in Sue's *Mystères de Paris;* indeed, the language of some of the characters in that work was so difficult to understand that it was found necessary to publish a *Dictionnaire complet de l'argot employé dans les Mystères de Paris.* Some of the argot words are very expressive: thus, God is *Mec des mecs* (*Maître des maîtres*, Master of masters); the devil, *boulanger* (baker); prison, *collége* or *abbaye de sots* (college, fools' abbey); the gibbet, *veuve* (widow); to suffer capital punishment, *épouser la veuve* (to marry the widow); a café, *bocard* (stamping mill); to eat, *jouer des dominos* (to play dominoes); an omnibus, *four banal* or *face à face* (parish oven, face to face); the sea, *la grande tasse* (the big cup); rain, *bouillon de chien* (dog soup); the moon, *moucharde* or *cafarde* (female spy, hypocrite); an Englishman, *goddem*, *rosbif*, &c.—In Spain the slang language is called *germania* (Lat. *germanus*, a full brother, hence faithful, true), from the brotherhoods or associations of thieves who make use of it. Some, with less probability, refer the name to the German origin of the earliest associations in Spain. Cervantes used some of its terms in "Don Quixote" and others of his works, and some are also to be found in the writings of Quevedo. In 1609 Juan Hidalgo compiled a book on the subject entitled *Romances de germania de varios autores, con su vocabulario*, &c. In germania a highway robber is called picturesquely *ermitano de camino* (hermit of the road); death, *cierta* (the certain); suspicion, *espino* (a thorn); a person hanged, *racimo* (bunch of grapes). In Portugal thieves' slang is called *calão*, perhaps from *calar*, to conceal. The slang of the Italian vagrants and thieves is called *furbesco* (from *furbo*, a quack, knave, rogue), and sometimes *gergo*, jargon. Some of its expressions are very suggestive: thus, hell is *calda casa* (hot house); a stone, *artone di calcosa* (earth bread); the mouth, *caverna* (cavern); the nose, *flauto* (flute); the tongue, *ingegnosa* (cunning); the stomach, *fagiana* (bean box); the beard, *bosco di berlo* (face forest).—The thieves' slang of Germany is called *Rothwälsch*, from *roth*, a cant term for vagrant, and *wälsch*, foreign. It is called also *Kokamloschen*, from the Hebrew *'hakham*, adroit, ingenious, and *lashon*, language. It is composed of Low, High, Jew, and gypsy German, has a grammar and almost a literature of its own, and two dialects, one in North and one in South Germany. Among its words are: custom house officer, *Auskätscher* (one who rummages everything); lawyer, *Diftler* (one who finesses); night, *schwarz* (black); priest, *Schwarzfärber* (black dyer); gold, *Fuchs* (fox); sword, *Kehrum* (face about). One of the earliest and most curious books on *Rothwälsch*, entitled *Von den falschen Bettlern und ihrer Büberey* (Wittenberg, 1528), has a preface by Martin Luther. A vocabulary of it was published in 1661, and since that time many other works have appeared.—In Jutland a slang allied to German cant is much spoken. The Czech thieves' cant is called *hantyrka*. The slang language of Holland is the *bargoens* or *dieventael*. In Norway, Sweden, and Denmark, besides the *fantasprog*, spoken of in Sund's work, *Om Fante eller Landstrygerfolket y Norge* (Christiania, 1850), are used the *tatersproget*, or gypsy gibberish, and the *sköiersproget*, the jargon of thieves and vagabonds. Russian thieves make use of different slang dialects, and several of the dissenting religious sects have languages peculiar to themselves. In Albania a slang language made up of a mixture of modern Greek, Wallachian, Italian, and Latin, with a few words of oriental invention, is spoken chiefly by quack doctors. In it the verbs signifying to practise medicine and to cheat are synonymous. Asiatic criminals speak the *balaibalan*, an artificial language made from the Arab, Persian, and Turkish vocabularies. The Indian Thugs speak the *ramaseena* language, a vocabulary and history of which appeared in Calcutta in 1836.

**SLATE,** a rock of no definite composition, distinguished by its structure, which is of parallel sheets or laminæ, easily separated. The term is in common use also applied to various rocks which do not possess the fissile character in so eminent a degree, and which are sometimes distinguished from the true slates by the name of schists; such are the mica, talcose, hornblende, and chlorite schists or slates. Shale differs from slate in its more earthy texture and less tenacity, as well as want of the perfect slaty structure. But its composition is like that of the argillaceous or clay slate, which is the well known roofing and writing slate. This variety, which is the only slate of economical importance, is found among the metamorphic rocks passing into mica slate, and with the strata of the Silurian period, and sometimes with those of still later origin. It is eminently characterized by splitting with ease into large smooth plates, which have a uniform degree of hardness, possess a dull or feeble lustre, and are blackish gray, bluish black, bluish or reddish brown, purplish, or greenish. The rock is often traversed by thin seams of quartz, but the prepared slates should be entirely free from foreign minerals, and especially from iron pyrites, which are too often seen in yellow cubical crystals scattered over the surface of what would otherwise be excellent roofing slates. Such are unfit for writing or school slates; and for roofing slates they are objectionable on account of the pyrites weakening the slates, and also being liable to decompose after exposure for some time, and cause unsightly stains of oxide of iron. Carbonate of lime is also sometimes present, and is likewise injurious. The best slates are distinguished by an appearance of compactness and solidity in the blocks, with nothing to suggest their fissile character; and yet this should be so perfect, that when fresh from the quarry these blocks may be split with greater ease than

pine timber, and into sheets of any desired thinness.. The faces should be perfectly smooth and parallel, without any curvatures or irregularities. There should be no lines of cross fracture that should prevent their breaking in any one direction more than another. When one is balanced on the finger and struck with a hammer, it should give a clear ringing sound; and after being dried in an oven and immersed in water, it should absorb but little, as may be ascertained by weighing it before and after immersion. This is an excellent test of the comparative values of different slates. The powder of slates is light gray, and when a pointed piece is rubbed upon a smooth slate surface a portion of the powder remains behind, leaving a plain mark that is easily wiped or washed off. It is this property which renders the slates serviceable for drawing and writing upon. Argillaceous slates, like the clays which they originally were, are essentially composed of silex and alumina, and the following is the result of the analysis of a common Scotch variety: silex, 50 parts in 100; alumina, 27; oxide and sulphate of iron, 11; potash, 4; magnesia, 1; water, 7; carbon, a trace. The slates are found often in beds of great extent, associated with other beds of similar character; and this singular feature is observed in the structure of the rocks, that the cleavage, or lines along which the slates naturally separate, has no relation to the lines of stratification. However much the beds themselves may be contorted and follow irregular waving planes, each system of cleavage lines, in case there are more than one, as sometimes occurs, maintains its own direction and rarely coincides with the plane of dip. It is evident that the cleavage seams must have been produced subsequently to the time when the beds acquired their final position. This structure is what is known as slaty cleavage; and sometimes when the strata are themselves thinly bedded and the stratification is regular over extended areas, it is not easy to distinguish immediately the two sets of planes one from the other.—Slates are quarried either by blasting out large slabs, or, when practicable, splitting them off with gads and large wedges. The slabs from a foot to a foot and a half thick, and it may be 8 or 10 ft. long and 1 or 2 ft. wide, are set on edge, and grooves are cut across the top and down the sides to determine the lines of fracture for separating them into rectangular blocks, which is done by blows from a wooden beetle directed upon the top near the furrow. The splitting is effected by driving wide, thin chisels between the laminæ, and the sizes of the slates are reduced whenever desirable by cutting cross grooves and then breaking the pieces with the chisel. When reduced to the required thinness, the slates are roughly dressed over the edge of a block of wood by the blows of a sort of chopping knife called a sack, sax, or zax. On the back of this tool is a sharp tapering steel point, with which the workman when preparing roofing slates pecks two holes through the slates near what is to be the head or upper edge, for the nails which are to hold it down to the roof. In Vermont machines have been applied to cutting grooves in the slate in the ledge to facilitate the quarrying, and the cutting and trimming are also done by machinery. It is important that all this work should be done while the blocks are fresh from the quarry, as in drying they are apt to lose their property of splitting freely, though freezing may restore this; but a succession of frosts and thaws has the effect of thorough seasoning. Slabs for internal decoration, as mantelpieces, and for articles of furniture, as table tops, billiard tables, sinks, &c., are cut by circular saws which are made to revolve slowly. The sheets when thus squared to suitable sizes are planed in machines similar to those used for planing metals; and pieces for mouldings are shaped by tools of the desired figure. Various ornamental articles are prepared of slate in imitation of marbles, granites, and other stones, by the application of colors, which are baked in, varnished, and polished, the applications being several times repeated. (See Enamelling, vol. vi., p. 591.)—Slate Pencils are made from argillaceous slate rock, sometimes from talcose slate, and sometimes from various materials ground together and compressed. Near the town of Castleton, and near one extremity of the western Vermont slate belt, is found an argillaceous slate from which the finest pencils are made. The stone is sawed into blocks 7 in. long by 6 in. wide, and split into slabs a little more than a quarter of an inch thick. These are then planed and placed in a machine, in which a series of grooved knives cut through one half the thickness of the slab, when it is placed in a second machine having a bed with grooves corresponding to the sides of the pencils cut, and a cutter like the one in the first machine completes the operation. The pencils are then counted and put up in boxes of 100 each, and packed in cases of 10,000. There are three sizes, 6, 5, and 4 in. in length. The waste of this slate has been utilized by grinding it into flour and making it into artificial pencils.

**SLATER, Samuel,** an American manufacturer, born at Belper, Derbyshire, England, June 9, 1768, died at Webster, Mass., April 21, 1835. He was apprenticed to cotton spinning under Jedidiah Strutt, partner of Arkwright, and was a favorite with his master. He aided Mr. Strutt in making improvements in his mills, and gained a thorough mastery of the theory and practice of the new manufacture. In 1789 congress passed its first act for the encouragement of manufactures, and the Pennsylvania legislature offered a bounty for the introduction of the Arkwright patents. These laws met the eye of young Slater in an English journal, and he believed himself able to carry the Arkwright cotton manufacture across the Atlantic without drawings or models, the export being forbidden under severe penalties. He arrived

in New York in November, 1789, and learned accidentally that Moses Brown had made some attempts at cotton spinning by machinery in Rhode Island. He wrote to Mr. Brown informing him of what he could do, and received a reply stating that these attempts had not been successful, and adding: "If thou canst do this thing, I invite thee to come to Rhode Island and have the credit and the profit of introducing cotton manufacture into America." Slater proceeded thither, and immediately entered into articles of agreement with William Almy and Smith Brown to construct and operate the new cotton-spinning machinery. On Dec. 21, 1790, he started at Pawtucket three 18-inch carding machines, the necessary drawing heads with two rolls and four processes, the roving cases and winders for the same, and throstle spinning frames of 72 spindles. Reels were soon after made for putting the yarn into skeins, in which form it was then exclusively marketed. The first yarns made on this machinery were equal in quality to the best made at that time in England. The growth of cotton manufacture was for some time necessarily slow, as the cotton was picked by hand in families. Further progress was made some years later when yarn was dyed and distributed in families for weaving. In 1812 Slater began the erection of mills in Oxford (now Webster), Mass., adding in 1815–'16 the manufacture of woollen cloths; and here has grown up the large establishment which still bears his name. He established in 1796, for the improvement of his workpeople, a Sunday school, which was the first or among the first in the United States.

**SLAVE COAST,** a part of the coast of Upper Guinea, W. Africa, between the rivers Volta and Cameroons, comprising a small part of the British Gold Coast protectorate, the coast of Dahomey, the British colony of Lagos, and the coast of Benin and Calabar. It derived its name from the trade in slaves, formerly the chief traffic of the coast. (See Guinea.)

**SLAVERY,** the condition of absolute bondage, in which one person is the unconditional property or chattel of another, and obliged to labor for his master's benefit, without his own consent. It has existed in some form in all nations, and still exists in many countries, though modern slavery differs in several respects from ancient slavery. It was in perfect existence at the dawn of history, and allusions to it are found in some of the earliest extant writings. Kidnapping was a common mode of obtaining slaves for commerce, and it was extensively followed by the Phœnicians as much as 3,000 years ago, and the slave trade was then in full vigor. Slavery first appears in Chinese records about 13 centuries B. C. In India the number of slaves was small, and it has even been asserted that slavery was there prohibited by positive law; but the lower castes could be enslaved for debt. Slavery existed among the Assyrians, the Babylonians, and the Persians after they had become conquerors. The conquering races who established their rule, in succession, in that quarter of the globe, found slavery there existing, and in some instances they increased its extent; but the general tendency of extensive conquests was to lessen the number of slaves, for when different races became subject to the same royal line, and peace prevailed, as in the Persian empire, which extended from the borders of Ethiopia to India, the supplies of slaves were largely cut off, as those supplies were principally obtained through war. The Hebrews had some form of slavery from the time of Abraham. The Mosaic legislation concerning servitude was very mild, and contained numerous important limitations of the rights of masters. In Phœnicia slaves were very numerous, and were extensively employed in all the branches of industry that were pursued by that enterprising people. They formed much the larger part of the populations of such cities as Tyre and Sidon.—Slavery was a firmly established institution of the Hellenic heroic age. It was the consequence of invasion and conquest, and it led to further wars that were waged in order to procure more slaves. Piracy and kidnapping were resorted to for the same object, and no degree of life was exempt from the effects of this state of things. Yet in the heroic age Grecian slavery was mild. "In Homer," it has been truly said, "the condition of the slave seems everywhere tempered by the kindness and indulgence of the master." The condition of women, however, was worse than that of men. The female slaves performed the principal work in the interior of the house. Not only do they seem to have been more harshly treated than the males, but they were charged with the hardest and most exhausting labor which the establishment of a Greek chief required. The treatment of slaves was very different by the different Greek communities. The Athenians were very kind toward them, and throughout Attica prevailed the mildest form of servitude known to the world of antiquity. Athenian legislation protected the personal rights of the slave, and promoted his efforts to obtain freedom. There were both public and private slaves at Athens, the former being the property of the state, some of whom were educated and filled important offices, such as those of secretaries of the commanders and treasurers of the armies. Sparta was regarded by Greece as furnishing the practical antithesis to Athens in the treatment of slaves. The helots of Sparta furnish the type of all that is calamitous among the oppressed, and there is much in Spartan history that justifies this view of their condition. They were slaves of the state, and those by whom they were held could neither liberate them nor sell them out of Laconia. They appear to have occupied some such position as the serfs of the middle ages, but the central authority had more power over them. (See Helots.) The supplies of slaves were obtained

in most parts of Greece through war, commerce, piracy, and kidnapping. There were regular markets for their sale, the principal of which were held at Athens, Samos, and Chios. Negroes were among the slaves imported, Egypt furnishing the larger number of them; and they were valued for their complexion, and considered as luxuries. Most of the domestic and personal slaves were barbarians, that is, persons who were not of Greek blood, for it was the Grecian custom to allow prisoners of their own race to be ransomed. The number of slaves in Greece was very large, and it is even estimated to have been three or four times as great as that of the free population. Unlike the Romans, the Greeks did not seek to possess many slaves from motives of luxury and ostentation, but of profit. Fifty slaves were a large number for a wealthy Athenian to own, while some Romans owned 20,000 each. There were many slaves employed in the mines, but they were of the least valuable kind, and their labor was destructive of life. Most of the slave insurrections in Attica were brought about by the mining slaves, and on one occasion they took possession of Sunium, and held it for some time. The Athenian slaves were not, save on extraordinary occasions, employed as soldiers, like those of the Dorian Greeks. They fought at Marathon and at the Arginusæ, but these were remarkable exceptions. Manumitted slaves in Greece could not become citizens, but became metics, and were still under certain obligations to their former masters, neglect of which made them liable to be sold into slavery again.—In Italy slavery prevailed even more extensively than in Greece, though in the early times, it has been contended, and before the foundation of the Roman dominion, the number of slaves was so small, and they were so well treated, as hardly to deserve the name; but as there is evidence that the Etruscans had negro slaves, the slave trade must have been extensively carried on between Italy and Africa at a remote period. The Romans had slaves at the earliest dates of their annals, and far earlier than that time which is recognized as the beginning of their authentic history; but there was a great difference between the institution as it existed in the opening years of the republic and as it became several generations before the establishment of the imperial rule. As the kingdom of Rome is believed to have been far more powerful than was the Roman republic during the first two centuries of its existence, and had commercial relations with the Carthaginians, the principal slave traders of the time, the just conclusion is that slavery was more extensive under the later kings than it was under the prætors and early consuls. In the early times nearly all the domestics of the Romans were slaves, and so were the majority of the operatives in town; but that excess of agricultural slaves which in later times became a marked feature of Roman industrial life was then unknown. Agriculture was considered an honorable pursuit, and the haughtiest of the patricians often cultivated their fields with their own hands; for they were not all rich, as the story of Cincinnatus shows. The first slaves of the Romans were exclusively prisoners of war made from the peoples in their immediate vicinity, and sold at auction by the state as booty; they strongly resembled their masters, so that their condition was probably not hard; but there was a constant change for the worse as the circle of Roman conquest extended. So long as the wars of the Romans were confined to their own immediate part of the world, the numbers obtained by war could not have been very large; but when their armies began to contend with distant peoples, and to conquer them, they were counted by myriads. They acted on the principle of sparing the humble and subduing the proud, granting both life and liberty to those who surrendered, but taking captive all those who resisted their arms, and consigning such of them to slavery as were not reserved for a fate more immediately severe. The Romans were not sparing in the infliction of this rule of war, and the consequence was, not only that the slave population was rapidly increased, but that it was made to include the most cultivated classes of the most cultivated period of antiquity, as the Roman conquests did not begin until after the highest of ancient races had completed their development. Roman slavery began to assume its great proportions in the same age that saw the beginning of its long quarrel with Carthage, which opened in 264 B. C. When the Romans made their first invasion of Africa, 256 B. C., under Regulus, they landed in a portion of the Carthaginian territory lying between the Hermæan headland and the Lesser Syrtis. This fine country was given up to all the horrors of ancient warfare, "and 20,000 persons, many of them doubtless of the highest condition, and bred up in all the enjoyments of domestic peace and affluence, were carried away as slaves." Most of the captives taken at the conquest of Carthage, who had surrendered, were sold into slavery. This treatment of the Carthaginians, a high-bred and refined people, shows the character of Roman slavery, which was not confined to the barbarous races, or to any peculiar people, but swept all within its nets who could be conquered or purchased. Corinth, one of the richest and most luxurious cities of Greece, was destroyed at the same time with Carthage, and the Corinthians were all sold into slavery; and nothing but the influence of Polybius with the younger Scipio Africanus prevented the entire population of the Peloponnesus from sharing their fate. Two generations earlier, Capua, a city not inferior to Carthage or Corinth in culture, the wealth and magnificence of which were proverbial, had many of its best citizens sold into slavery, their wives and

children being also thus sold; "and it was especially ordered that they should be sold at Rome, lest some of their countrymen or neighbors should purchase them for the purpose of restoring their liberty." After the close of the second Punic war, the conquests of Rome went on with great rapidity, and the numbers of the slave population increased at the same rate, so that in 70 years even the free agricultural population of Italy had mostly disappeared. The absorption of small freeholds in large estates, along with war, led to the decrease of that population, and the places thus made vacant were filled by the purchase of slaves, the latter being taken in war to a considerable extent, though the slave traders were by no means idle. One of the consequences of the successes of Æmilius Paulus in Macedonia was the sale of 150,000 Epirotes, who had been seized because their country was friendly to Perseus. The demand for slaves became very great full two centuries B. C. in Sicily, which had then fallen completely under the Roman dominion, and because corn was much wanted in Italy, then beginning to recover from the effect of the Carthaginian invasion and occupation; and the state of things in Sicily was so favorable to the aggregation of wealth, that it soon extended to Italy, where the land passed into the hands of the few. Great estates succeeding to the many small farms that had been known in the preceding generations, the soil was now cultivated or attended to by great masses of slaves, the property chiefly of the leading members of the *optimates*, or the high aristocratical party. The wars in Spain, Illyria, Greece, Syria, and Macedonia furnished large numbers of slaves, the common sorts of whom were sold at low rates, and were employed in the country. The invasion of the Roman territories by the Teutones and Cimbri, which ended in the total defeat of those barbarians by Marius, added considerably to the number of slaves, 60,000 of the Cimbri alone being taken captive in the last great battle of the war. The conquests of Sulla, Lucullus, and Pompey in Greece and the East, actually flooded the slave markets, so that in the camp of Lucullus, in Pontus, men were sold for four drachmæ each, or about 62 cents of our money. Cicero sold about 10,000 of the inhabitants of the Cilician town of Pindenissus. The Gallic wars of Julius Cæsar furnished almost half a million slaves; and Augustus sold 36,000 of the Salassi, nearly a fourth of whom were men of military age. In the Jewish war which ended in the destruction of Jerusalem, 90,000 persons were made captives. But Roman slavery would not have been so comprehensive if the Romans had been compelled to rely solely upon war for slaves. Commerce has been a chief means of feeding slavery from the beginning of the world. Before the Romans had obtained dominion over Italy, they were slave purchasers from the Carthaginians, who drew their principal supplies of men from the interior of Africa, the slave trade of that region, like that of Asia and Greece, being much older than history. Many slaves were obtained by commerce from the East, and the cities on the shores of the Euxine were among the chief slave marts of antiquity far down into the days of the empire. Barbarians of whom the Romans otherwise knew nothing found their way to the imperial city as slaves. At the height of her power Rome had slaves from Britain, Gaul, Scandinavia, Germany, Sarmatia, Dacia, Spain, the different countries of Africa, from Egypt to the Troglodytes of Ethiopia, the western Mediterranean islands, Sicily, Greece, Illyria, Thrace, Macedonia, Bithynia, Phrygia, Cappadocia, Syria, Media, and almost every other country to which ambition or avarice could lead the soldier or the trader to penetrate. All races furnished their contributions to the greatest population of slaves that ever existed under one dominion. Unlike the Greeks, the Romans "acknowledged the general equality of the human species, and confessed the dominion of masters to flow entirely from the will of society;" but this did not prevent them from enslaving all men upon whom they could lay their hands, while they were much harsher toward their slaves than the Greeks were. Not a few slaves were procured by kidnapping persons, and it was notorious that even Roman freemen were seized and shut up in the *ergastula* of the great proprietors, which invasion of personal rights the whole power of the government was unable to prevent. Children were sometimes sold into slavery by their parents, either from love of gain or to save them from starvation; and the number of these sales was large in times of general distress. Men were also sold for debts due to the imperial treasury. Under a variety of circumstances poor people could sell themselves into slavery, but such sales were not irrevocable until the second century of the empire, and then the law was somewhat limited, the object being to punish those who had sold themselves with the intention of reclaiming their freedom, the purchaser in such cases having no redress. Romans who had committed crimes that were ignominiously punished became slaves through that fact, and were known as *servi pœnæ*, or slaves of punishment, and were public property. They remained slaves even if pardoned, unless specially restored to citizenship; and it was not until the reign of Justinian that this form of slavery was abolished. In early times, persons who did not give in their names for enrolment in the public force were sold into slavery, after being beaten; and incorrect returns to the censors led to the same punishment. Poor thieves, who could not make a fourfold return of the amount of their booty, became slaves to the party stolen from; and a father could give up a child who had stolen to the prosecutor. Poor debtors were sold as slaves.—The em-

ployments of Roman slaves, both public and private, were very various, and were minutely subdivided. Besides filling all the more menial offices, many of them occupied the positions of librarians, readers, reciters, story tellers, journal keepers, amanuenses, physicians and surgeons, architects, diviners, grammarians, penmen, musicians and singers, players, builders, engravers, antiquaries, illuminators, painters, silversmiths, gladiators, charioteers of the circus, &c. Before a slave could become a soldier he was emancipated, and into the Roman armies of the early republic not even freedmen were allowed to enter; but the demand for soldiers did away with this delicacy, and slaves were regularly enlisted in the second Punic war, and did good service to the state. Many of the Roman slaves were on the most intimate terms with their masters, and must have been well treated, or the state of society would have been intolerable; and we read of not a few instances in which the lives of masters were saved by their slaves, in the times of the proscriptions and massacres of Marius and Sulla, and of the triumvirs, and on other occasions. But the masses of the slaves were treated harshly, and the laws and regulations affecting them were mostly severe. The Romans were generally hard masters; and "the original condition of slaves, in relation to freemen, was as low as can be conceived. They were not considered members of the community, in which they had no station nor place. They possessed no rights, and were not deemed persons in law; so that they could neither sue nor be sued in any court of civil judicature, and they could not invoke the protection of the tribunes. So far were these notions carried, that when an alleged slave claimed his freedom on the ground of unjust detention in servitude, he was under the necessity of having a free protector to sue for him, till Justinian dispensed with that formality." Slaves were allowed only a special kind of marriage (*contubernium*), and they had no power over their children. Few of the ties of blood were recognized among them; and they could hold property only by the sanction or tolerance of their masters. The criminal law was equally harsh, slaves being treated under it as things, but it was gradually meliorated. The severest and most ignominious punishments were shared by slaves with the vilest malefactors, as crucifixion and hanging, and later they were burned alive. Under the empire the condition of the slaves was better than it had been under the republic. The emperors were, however, far from pursuing a uniform policy toward the servile class, and some of them even restored cruel laws that had been abolished. In theory Roman slavery was perpetual, and to this theory the practice conformed, inasmuch as by no act of his own could the slave become free. Freedom could proceed only from the action of the master. Manumission was not uncommon, and there were numerous freedmen who exercised much influence, as well in public life as in families. Freedom was the reward of good conduct, and the ease with which the places of freed slaves could be filled up by new purchases made manumission much more frequent than it would have been under other circumstances. Dying masters freed slaves by the hundred, in order that they might swell their funeral processions. On joyful occasions a wealthy master would manumit many of his slaves. Sometimes slaves were liberated in the article of death, in order that they might die in freedom. Manumission was often the result of agreement between masters and slaves, the latter either purchasing freedom with money, or binding themselves to pursue certain courses that should be for their former owner's interest. The republican period was favorable to emancipation, and freedmen were so numerous at the formation of the empire that some of the early emperors sought to restrict manumission, less however to promote the interest of slaveholders, or to increase the number of slaves, than for the purpose of increasing the numbers of the ingenuous class, an object much thought of and aimed at by several generations of Roman statesmen, but always without success. The later emperors favored emancipation, particularly after they had become Christian; and Justinian removed nearly every obstacle to it. Augustus labored strenuously to limit emancipation, but even he had recourse to the society of freedmen, in accordance with a custom of the great men of his country; and in 30 years after his death the Roman world was governed by members of that class of persons. Julius Cæsar employed no freedmen, and Tiberius employed but few, and gave them none of his confidence, thus imitating Cæsar rather than Augustus; and even Caligula used them but little. Claudius they ruled, and through him the empire.—It is impossible to estimate with an approach to accuracy the number of Roman slaves. Gibbon thought it was equal to that of the free population, which Zumpt pronounces a "gross error;" and Blair estimates that during the 14 generations that followed the conquest of Greece, there were three slaves to one freeman. Gibbon's estimate, which applies to the reign of Claudius, would give 60,000,000, and probably it is not far from the truth, though we may agree with Blair that it seems much too low for those places which were inhabited by Romans properly so called. Many individuals owned immense numbers, though the figures in some of these cases are perhaps exaggerated, or the results of the mistakes of copyists. The prices of slaves were not fixed. Good doctors, actors, cooks, beautiful women, and skilled artists brought heavy sums, and "ruled high;" and so did handsome boys, eunuchs, and fools. Learned men, grammarians, and rhetoricians also sold at high rates. Some descriptions of artisans and laborers

would sell at good prices, upward of $300 of our money each; but $100 was a fair average price for a common slave, and when a slave could be bought for about half that sum the price was held to be low. Insurrections and servile wars were not uncommon. Two such wars broke out in Sicily after the conquest of that island by the Romans, and were extinguished only in the blood of myriads of men, and through the exertions of consular armies. Toward the close of the 7th century of Rome the war of the gladiators, waged on the one side by slaves alone, from general to camp servants, brought the republic to the verge of ruin. The war was commenced by a few gladiators from the schools of Capua, under the lead of Spartacus, a Thracian, 73 B. C., and lasted for more than two years. Several Roman armies, commanded by prætors and consuls, were defeated, and for a time the revolted slaves had the peninsula more at their command than it was at the command of the Romans. The country was horribly ravaged, and it was not until Crassus took the field, and 200,000 men were employed, that the insurrection was subdued; and the final battle was won by the Romans more as the consequence of the death of Spartacus before it was half fought than from their superior generalship. Six thousand of the slaves were hanged or crucified after their defeat. The punishment of rebellious slaves was always very severe. Many slaves had enlisted under Sextus Pompey, and thousands of them who fell into the hands of Octavius were sent to the horrible death of the cross, with the general approbation of the citizens. They were crucified solely as fugitives, as all whose masters could be found were restored to them; and the cruel act was perpetrated in violation of plighted faith. It more than once happened that Roman leaders in the civil wars either called upon slaves to rebel, or availed themselves of the services of slaves. Marius, on his return from Africa to Italy, and just before his death, proclaimed liberty to all slaves who would join him, and at least 4,000 enlisted under his banner. Before his exile he had tried the same plan, but without success. The Cornelians of Sulla were 10,000 freed slaves, who had belonged to members of the Marian party that had been proscribed by the conqueror, and who took their appellation from the gentile name of their patron.—The slave trade of antiquity comprehended the whole hemisphere in its circle. Its origin is unknown, for it was practised in all its parts at the earliest period of which any knowledge is to be obtained. The Phœnician slave trade was very extensive, and supplied in part by piracy. They stole Greeks and sold them 12 centuries before Christ, and they also sold stolen people to the Greeks. They had a land traffic in slaves, obtaining them in the countries between the Black and Caspian seas; and they exchanged Hebrew slaves for the productions of Arabia with the Sabæans and Edomites. The Greeks were also great slave traders, and were as skilful in kidnapping persons as were the Phœnicians. Their slave traffic extended to Egypt, Thrace, Phrygia, Lydia, Syria, and other countries. From Egypt they obtained blacks, then regarded as slaves of luxury. Their slaves came mostly from the north and the east. The chief Grecian slave marts were Athens, Samos, Chios, Ephesus, Cyprus, and Corinth. The Carthaginians, who were the Phœnicians of the west, rivalled their progenitors in the extent and comprehensiveness of their slave traffic. They had an immense traffic with the interior of Africa, a caravan trade, like that of the Egyptians and of the Cyrenæans. Women were preferred to men in the trade with the African slave dealers, as they sold for much higher prices in some northern countries. There was a large demand for negroes in the Balearic islands, and especially for women. Corsica also furnished many valuable slaves to the Carthaginians. The Roman slave trade as much exceeded that of any other country of antiquity as the institution of Roman slavery exceeded slavery in other countries. In remoter times the Romans were no better than robbers in their treatment of foreigners, imitating the Etruscans in this respect, who were the worst pirates of antiquity. Corinth had been the chief slave mart of Greece toward the close of its independence, before it fell into the hands of the Romans, and at the time when slavery was beginning to increase rapidly in Italy; and it is supposed, its situation being favorable to trade of the kind, that many slaves were sent thence from the East to the cities on the eastern Italian coast. But the destruction of Corinth by the Romans, 146 B. C., transferred the slave trade to Delos, which became the most noted slave market of that age, though the trade in slaves was but one branch of the immense commerce that centred there. The importance of the slave trade in that island was owing to the Roman demand, as it was most favorably situated to minister to the desire for slaves from eastern countries—Greeks, Syrians, Phrygians, Bithynians, and others. According to Strabo, it was possible, so complete were the arrangements, to import 10,000 slaves in one day, and to export them on the same day. But all this prosperity came to an end when the forces of Mithridates entered Greece. They landed on Delos, and devastated the island, so that it never recovered from their ravages. The Mediterranean pirates had supplied Delos with many slaves; and at Side, in Pamphylia, they had a great market of their own, at which they disposed of their captives, many of whom were captured far inland, even Italy itself not being safe from their ravages, and its villas and highroads furnishing victims to the marauders, who became very powerful during that disturbed period of Roman history in which occurred the social war and the contest between Marius and Sulla. From Alexandria the Romans obtained

slaves, Egyptians and Ethiopians, that city having a great trade in men. Others were drawn from Thrace, which continued to be a slave-breeding country long after the fall of Greece. After the devastation of Delos, the slave trade fell back nearer to its sources, and the Romans obtained slaves direct from the marts on the Euxine, where the trade had existed from time immemorial, being fed by the constant warfare that was waged by the neighboring tribes. Many came from Scythia, and Scythian and slave were all but convertible terms. The Galatians carried on an extensive slave trade; and between Italy and Illyria this commerce was considerable in the first days of the empire. The Roman wars fed the slave trade, and enabled those who carried it on to accumulate immense fortunes. So long as those wars were fought near home, the victors could sell their captives easily, without much aid from traders; but as soon as they extended to any distance from Italy, the trader's aid became necessary. The trader followed the camp, and in the camp the human booty was sold, and often at prices so low as to appear incredible. The Romans neither encouraged nor discouraged the slave trade. They held the slave trader in contempt, and deemed his business utterly unworthy of merchants. Special names were given to such traders, implying that they were necessarily cheats; but their enormous wealth made them powerful.—Slavery is regarded as one of the chief causes of the decline of Rome. The institution existed in all parts of the Roman empire, and prevailed in the countries which were formed from its fragments, though essentially modified by a variety of circumstances. The influence of Christianity upon it was very great. It had indeed existed before the extension of the Roman dominion, and was known to most of the peoples who invaded and overthrew the empire, and on its ruins established the feudal system and serfdom. (See SERF.) The rise of the Saracens tended to increase the number of slaves, and to feed the trade in them, as Christians felt no scruples about enslaving Mussulmans, and the Mussulmans were quite as unscrupulous toward Christians. The wars between the Germans and Slavs furnished so many of the latter race for the market, that the word slave is derived from them. The great commercial republics of Italy were much engaged in slave trading. The Venetians had many slaves, and the history of their commerce shows that they pursued the slave trade with vigor and profit. In spite of the efforts of the popes, they sold Christians to Moslems. Slavery also existed in Florence, though the slaves were almost exclusively Moslems and other unransomed prisoners of war. In England, under the Saxons, the slave trade flourished, Bristol being the chief mart, whence many slaves were exported to Ireland. But in this island slaveholding was never very popular, and the Irish early emancipated their bondmen.—At the close of the middle ages two peculiar forms of slavery and the slave trade began to be known, one of which has but recently ceased to exist, while the other is not yet entirely extinguished. The new phase of Mohammedanism that came up with the rapid development of the power of the Turks, in the 14th and 15th centuries, nearly synchronizes with the origin and progress of what is known specifically as negro slavery. The Turks completed the establishment of their power in Europe by the conquest of Constantinople in 1453; and not quite 40 years later the last Mussulman state in Spain, Granada, was conquered by the Christians. These two events had a remarkable effect on slavery. The fears of Christendom were excited by the rapid and sweeping successes of the Turks, and the anger of the Mussulmans was roused by the overthrow and enslavement of their brethren in Spain; and from these feelings the system of slavery received an impetus and acquired forms that under other conditions it never could have known. We have seen that the church, at a much earlier period, did not object so much to the traffic in men as to the traffic in Christians, and that lay legislators took the same view of human duties; and it was also the case that the selling of Christians to Moslems was more strictly forbidden than was the selling of Christians to other Christians. The sentiment that prevailed while the Saracens were so strong as to excite fears throughout all Christendom for its safety, was revived in the 15th century, and did not become altogether extinct until after the middle of the 17th. In the East, and for the greater part of the time in most of N. Africa, the Mohammedans were in the ascendant, they having become masters of Barbary and lords of the Levant. Between the Turks on the one side and the Italians and Spaniards on the other the long struggle was principally carried on in the south, the English being too remote from the scene to take much part in it, while the French, though occasionally furnishing some gallant volunteers, were as a nation the friends and sometimes the allies of the infidels. The knights of St. John of Jerusalem, first in Palestine, then at Rhodes, and afterward at Malta, carried on perpetual warfare with the Mussulmans. The contending parties divided between them the whole of the sea dominion of the Romans, and the compound rivalry of religion and race doomed multitudes of civilized people to slavery. Men who were taken in war did not alone compose these slaves, but among them were many women and children, the victims of *razzias* that were undertaken by the parties to the bitter and prolonged contest. The light, low vessels of the Mussulmans often ran into the ports of the Spaniards and Italians by night, and plundered and burned them, while the inhabitants were either murdered or carried into captivity. Watch towers were built along the coasts, that the approach of the corsairs might be detected. So marked

a feature of the war then waged was this form of slavery, that it furnished much matter for the romantic literature of southern Europe, in which nothing is more common than incidents connected with bondage in Barbary. Cervantes himself was for five years an Algerine captive, and he formed a project for a slave insurrection, there being 25,000 enslaved Christians at that time in Algiers alone. Enormous numbers of captives were employed as rowers of galleys, Christians on board those of the Mussulmans and Mussulmans on board Christian vessels. When the Turks lost the battle of Lepanto, in 1571, 12,000 Christian captives, galley slaves, were released from the prizes made by the allied fleet. When Charles V. took Tunis, in 1535, 20,000 Christians were released from slavery. Great numbers of women were taken as slaves, and sold in the markets of Turkey and Barbary. The corsairs passed out of the Mediterranean, sailed far to the north, and seized people on the coast of Ireland. This brought upon them punishment from the English, but that did not put an end to their Atlantic cruising. There were some places in Barbary on the Atlantic from which corsairs sailed, and those of Salé were among the most famous of the brotherhood. The European powers made frequent war on the Barbary states; and of the early contests in which the American Union was engaged none were more brilliant than those which it carried on with some of those states, in defence of the liberty and commerce of its citizens. But the jealousies of the European powers prevented them from putting an end to the piracy and slavery of Barbary long after the Turks had ceased to be able to protect the corsairs, and tribute was paid to the petty powers down to the beginning of the 19th century. The successful bombardment of Algiers in 1816, by an English fleet commanded by Lord Exmouth, put an end to white slavery in Barbary, it having previously ceased to exist in the other countries of N. Africa, to which the exploits of the American navy had much contributed, though at first the government of the United States had paid tribute to the pirate chiefs.—At the same time that slavery was acquiring its peculiar form in the countries on the Mediterranean, negro or African slavery came into existence. This form of slavery belongs entirely to modern times. As we know, the slave trade in negroes existed 3,000 years ago at least, and the Carthaginians brought numbers of black slaves from central and southern Africa, by means of their caravan commerce, a mode of traffic that was common long before the Carthaginians had a political existence; but in trading in negroes, the slave traders of antiquity only did that which they did with all other descriptions of men, and as the slave traders of the East have always done until now. The fact that the ancients regarded black slaves as luxuries, proves that their number could not have been large in the European countries to which they were taken, either by the way of Egypt or that of Carthage. Such details as we have concerning the black slaves of antiquity all serve to show that they were not numerous, far less so indeed than were slaves belonging to some of the highest of the white races. They were probably more numerous in the East than in Greece and Italy, and most numerous of all in Egypt and other parts of N. Africa, because of the comparative ease of acquiring them in those countries. The Venetians, who carried on a large trade with Africa, no doubt distributed some negro slaves over the various European nations which they visited. In the Mohammedan countries there have been black slaves from the time of the prophet, and they have often risen very high, as well in the state as in the household. But in all these cases the negro has but shared the common lot, and might have been sold on the same day with the Greek or the Arab, and by the same trader. The negro was then sold, not because he was a negro, but because he was a man whose services could be turned to profitable account. Negro slavery, in its special form, is one of the consequences of that grand movement in behalf of maritime discovery and commerce which began in the 15th century. Portugal took the lead in this movement, which was already prominent more than four centuries ago; and it was headed in that country by Prince Henry, son of John I. In 1441 two of Prince Henry's captains seized some Moors, who were taken to Portugal. The next year these Moors were allowed to ransom themselves, and among the goods given in exchange for them were ten black slaves, whose appearance in Portugal excited general astonishment, and who led the van of the African slave trade. This was openly commenced in 1444, by a company formed at Lagos; and though it is doubtful whether that company was formed expressly to trade in men, and it is by no means certain that the 200 persons whom its agents seized and brought to Europe were negroes, it is from that time that the negro trade is generally dated. The first negroes taken by the Portuguese in the negro country were but four in number, in 1445, and they were rather taken accidentally than of set purpose to make them slaves; but the trade in negroes as slaves was quickly regulated, and a Portuguese factory was established in one of the Arguin islands, where the slave trade had been commenced. Every year 700 or 800 black slaves were sent from this factory to Portugal, while other slaves of the same description from the countries that furnished those sent to Portugal were sold to other traders, who took them to Tunis and to Sicily. But Prince Henry and those who followed in his path did not regard the trade in slaves as a thing to be encouraged. They thought rather of the conversion of the Africans to Christianity, both the Portuguese and Spanish discoverers being enthusiastic propa-

gandists. Had it not been for the discovery of America in 1492, it is altogether probable that the African slave trade would never have exceeded the dimensions it had known in antiquity; and it is believed that between 1455 and 1492 that trade had fallen off considerably, and that the number of negroes taken by the Portuguese for exportation did not exceed 300 or 400 a year. In fact, Europe presented no field for the labor of black slaves, the employment of which must have been confined to the houses of the great, as in the classic times, with rare exceptions. The negro trade was verging to extinction, when the success of the great enterprise of Columbus imparted to it new life, and made it one of the most lucrative branches of commerce.—Soon after the discovery of America the Spaniards began to enslave the natives, large numbers of whom were sent to Spain as slaves in 1495. The system of *repartimientos* (slave distributions) was begun in 1496. Columbus appears to have had no scruples on the subject, and had indeed been engaged in the Portuguese slave trade. He strongly recommended the trade in the cannibal Indians; and the Spanish sovereigns, though in general their legislation was kindly toward the natives, did not discourage his proposition. At a later period Isabella sought to make a distinction between Indians who had been sold into slavery after being taken in war, and others who had been seized in consequence of failure to pay tribute; and she was very angry with "the admiral" for making the seizure, and ordered the sufferers to be released and returned to America. Under the Spanish rule the Indians perished in immense numbers, until they became extinct in the islands, or were absorbed by the other races. Slavery itself was not unknown in America, and had a well defined system in Mexico. The desire of the Spaniards to have laborers, and the inability of the natives to perform the labors required of them, soon led to the sending of negroes to the new world. Interest and humanity promoted their rapid increase in the Spanish colonies. They could perform the work to which the Indians were unequal, and throve under it. The government of Ferdinand feared that the sending of many negroes to America would prove injurious, but Charles V. granted a license to a Fleming to import negroes into the West Indies. Thenceforth the trade went on vigorously. The demand of the colonists for negroes was supported by the benevolent Las Casas, and by other leaders in the Roman Catholic church, who were desirous of preventing the extinction of the Indians. One negro was counted as worth four natives. There was a negro insurrection in Hispaniola as early as 1522. The African slave trade, under such stimulus as was afforded by the American demand, rapidly increased, and England took part in the work of supplying the Spaniards in 1562, previously to which negroes had been landed in England, and there sold, in 1553. Queen Elizabeth is charged with sharing the profits made by Sir John Hawkins, the first Englishman who commanded a regular slave trader. The English were far more cruel traders than the Portuguese. In the times of the Stuarts four English companies were chartered for carrying on the African slave trade, and Charles II. and James II. were members of the fourth company. While duke of York, James II. was at the head of the last company. After the revolution the trade was thrown open to all; and at later periods the royal African company received aid from parliament. These companies furnished negroes to America; and in 1713 the privilege of supplying them to the Spanish colonies was secured to Englishmen for 30 years, during which 144,000 were to be landed. The French, the Dutch, and other European nations engaged in the traffic; and the first slaves brought to the old territory of the United States were sold from a Dutch vessel, which landed 20 at Jamestown, Virginia, in 1619. The culture of cotton began the next year. Slavery soon came into existence in nearly every part of North America, and Indians were enslaved as well as negroes. The son of King Philip was sold as a slave. The trade between North America and Africa was carried on with considerable vigor. Some of the colonies remonstrated against the trade, but without success, as the mother country encouraged it. In 1776 it was resolved by the continental congress that no more slaves should be imported; but when the American constitution was formed, in 1788, congress was prohibited from interdicting the traffic before 1808, at which time it was abolished. The state of Georgia prohibited the slave trade in 1798. America was thus in advance of other countries in fixing a time for the cessation of a traffic which has been as generally condemned as it has been persistently pursued for four centuries. In England the slave trade was early denounced by individuals, but it was regarded by most men as a perfectly legitimate branch of commerce. The last act of the British legislature regulating the slave trade was passed in 1788, the same year that the first parliamentary movement for the abolition of the trade was made. The Quakers were opposed to slavery and the slave trade from the beginning of their existence as a body, but neither their influence nor their numbers were large. English lawyers were nearly unanimous in their support of the legality of slavery, and the trade in negroes was in various ways encouraged by law. In the 18th century a sentiment of hostility to the system of slavery, never altogether unknown since the Christian era, became very common, and was shared by many literary men, philosophers, and statesmen, who labored with zeal for the suppression of the system. Of these, the most noted was Granville Sharp, who exerted himself for half a century in the emancipation cause; and it was chiefly through his labors

that the decision of Lord Mansfield, in the case of Somerset, was given in 1772, that decision being that the master of a slave could not by force compel him to go out of the kingdom. "The power of a master over his slave," the English chief justice of the court of king's bench observed, "has been extremely different in different countries. The state of slavery is of such a nature that it is incapable of being introduced on any reasons, moral or political, but only positive law, which preserves its force long after the reasons, occasions, and time itself from whence it was created are erased from memory. It is so odious that nothing can be suffered to support it but positive law. Whatever inconveniences, therefore, may follow from a decision, I cannot say this case is allowed or approved by the law of England, and therefore the black must be discharged." Lord Mansfield's decision has been greatly overrated as to the importance of its terms, and it is incorrect to say that it was the first in the order of time. More than ten years earlier, the admiralty court of Glasgow liberated a negro slave who had been imported into Scotland; and 70 years before, Chief Justice Holt ruled that "as soon as a negro comes into England he is free; one may be a villein in England, but not a slave;" and later: "In England there is no such thing as a slave, and a human being never was considered a chattel to be sold for a price." The decision of Lord Mansfield was made almost under compulsion, so strong was the feeling in England against slavery at that time; and immediately the enemies of both the trade and the institution went to work, and began those exertions which were not to cease until their country had abolished, first the commerce in negroes, and then the practice of enslaving them. The Quakers presented to parliament the first petition for the abolition of the slave trade. Mr. Clarkson began his anti-slavery labors in 1786, and Mr. Wilberforce joined him soon after. In June, 1787, a committee, composed of 12 members, all Quakers save Clarkson, Sharp, and another, was instituted for "effecting the abolition of the slave trade." In spite of the care they took to define their object and to conciliate popular prejudice, they encountered the violent opposition of the most eminent men of the country. The duke of Clarence denounced them in the house of lords as fanatics and hypocrites, including Wilberforce by name. The subject was brought before parliament, May 9, 1788, but the abolitionists were beaten, as they also were in 1789. Mr. Pitt, chief of the ministry, and Mr. Fox, chief of the opposition, joined them in 1790; and soon nearly all the leading members of the house of commons, of both parties, became abolitionists; but still defeat met every proposition for abolition till 1793, when the commons passed an act for the gradual abolition of the trade, which failed in the house of peers. The commons changed their mind in 1794, but passed another bill the next year, which the peers threw out. The agitation was continued, but the abolitionists failed in parliament till 1804, when another act passed by the commons was lost in the upper house. Another failure in the commons was experienced in 1805. In 1806, when the Fox and Grenville ministry ruled England, abolition was brought forward as a government measure, and was carried in 1807, after the death of Mr. Fox. The abolitionists then began to labor for the removal of slavery itself, but not with much effect till 1823, when a society was formed "for the mitigation and gradual abolition of slavery throughout the British dominions." The principal leaders in this new movement were Clarkson, Wilberforce, and Buxton. About this time appeared a pamphlet, written by Elizabeth Heyrick, a Quaker, and entitled "Immediate, not Gradual, Abolition." Her views did not at first command the assent of those who controlled the operations of the society, but subsequent reflection and discussion, and the resistance of the colonial authorities to every scheme of amelioration proposed by parliament, finally led them almost unanimously to the conclusion that she was right, and they abandoned the doctrines and measures of gradualism for those of immediate and unqualified emancipation on the soil. The cause from this time advanced with great rapidity. The question exerted a controlling influence in the election of the reformed parliament in 1832, and when, near the close of the year, that body assembled, the government avowed its purpose to bring in a bill for the abolition of slavery. The anxiety of the abolitionists as to the character of the proposed measure led to a conference, composed of 369 delegates from every part of the kingdom. A deputation of more than 300 members of this conference had an audience with leading members of the cabinet, to urge the necessity of total and immediate emancipation. The government measure was brought forward April 23, 1833. It proposed an apprenticeship of 12 years for the slaves, and to pay out of their earnings to the masters the sum of £15,000,000. The friends of emancipation remonstrated against these features of the plan, and it was finally modified by a reduction of the term of apprenticeship to six years, and a provision to pay the masters £20,000,000 out of the national treasury. The bill passed the house of commons Aug. 7, the house of lords Aug. 20, and received the royal assent Aug. 28, 1833. The day fixed for emancipation was Aug. 1, 1834, and it was left optional with the local legislatures respectively to adopt or reject the system of apprenticeship. Antigua and Bermuda rejected, while the other islands adopted the system. The apprenticeship system did not work well. In some instances the local legislatures voluntarily abolished it, and in 1838, two years before the time of its appointed expiration, it was brought to an end by act of parliament. In

1843 Great Britain emancipated more than 12,000,000 slaves in her East Indian possessions.—France had been as much committed to negro slavery as England, but moved sooner for its abolition. The national assembly, May 15, 1791, virtually granted equal political privileges to all free men without regard to color, and this led to those struggles in Santo Domingo which put an end to slavery there. Napoleon I. succeeded in restoring slavery in most of the French colonies, but failed in Hayti. In 1815, during the hundred days, he issued an order for the immediate abolition of the slave trade, which the government of Louis XVIII. reënacted, and the French slave trade ceased in 1819. The congress of Vienna denounced the slave trade. After much discussion in the reign of Louis Philippe, slavery in the French colonies was abolished by the provisional government in 1848, without indemnity to the masters. Sweden abolished slavery in 1846–'7, Denmark in 1848, and the Netherlands in 1862. Spain agreed in 1814 to abolish the slave trade in 1820. The Netherlands abolished it in 1818, and Brazil in 1826, but the Brazilians continued to prosecute it notwithstanding. In the United States it was prohibited by law from 1808. In 1820 a law was enacted declaring it piracy, but no conviction was obtained under this statute till November, 1861, when Nathaniel Gordon, master of a vessel called the Erie, was convicted at New York and executed. A similar statute was passed by the British parliament in 1825. But the trade by no means ceased because of these vigorous efforts for its abolition, which Great Britain and the United States supported by the presence of powerful fleets on the coast of Africa. The demand for slaves continued to be great, and the profits on the cargoes of slaves that were landed in various parts of America were so heavy that the traders could afford to lose many of their vessels. Not until the breaking out of the American civil war did the trade cease to be profitable, but that and the agitation for emancipation in Brazil nearly put an end to the slave trade across the Atlantic. In the interior of Africa it still has considerable vigor and constant activity, although it is much shorn of its profits by the loss of foreign markets.—Except in Cuba, slavery in Spanish America has disappeared. In Brazil it continued to flourish with considerable vigor till 1871. For several years preceding that date a strong agitation for its gradual abolition had existed, in which the emperor was understood to sympathize. The speech from the throne at the opening of the chamber on May 3, 1871, announced the belief of the government that the time had arrived for the final solution of the slavery controversy, and that a bill would be introduced for that purpose. The bill was finally acted upon Sept. 27, when it was adopted by a considerable majority. The children born of slaves from that date were to be considered free-born, but were to remain with the masters of the mothers until reaching the age of eight, when the master had the option to retain their services until they should be 21 years of age, or to receive from the government a compensation of 600 milreis. If he should accept the compensation, the government was to take charge of the minor and of his education. Every minor was to be at liberty to free himself from service by making compensation to the master proportioned to the period for which the service was to continue. Ill treatment or neglect of support or education was to entitle a child to his discharge from service. Children ceded or given to the government or taken from their masters by it might be delivered to privileged societies to be kept until they were 21, under an obligation securing them support and education. An emancipation fund, to be made up of certain taxes, the proceeds of certain lotteries, and other specified resources, together with donations, was to be employed annually in manumitting slaves, and they were to be entitled to purchase their freedom. The following classes were to be free: slaves of the nation; slaves given to the crown in usufruct; slaves of the religious orders (within seven years); slaves belonging to vacant inheritances; slaves who saved the lives of their masters, or the parents or children of their masters, and slaves given up by their masters. The law was received with general satisfaction. —The whole number of Africans taken for slaves is estimated at 40,000,000, or nearly 100,000 per annum since the beginning of the traffic; but for 80 years after the trade began their exportation was very limited, and probably not 30,000 were taken by the Portuguese between 1444 and 1493. The greatest part of the exportation was during the years that elapsed after movements for the abolition of the trade were commenced, the demand for tropical produce having immensely increased in the present century. Some of the slaves were sold in European countries, and it was supposed that there were 15,000 in the British islands at the time of the decision of the Somerset case. African slaves were said to be "dispersed all over Europe." Spain and France took some of them, as well as England. The number of slaves imported into those British colonies which became the United States in 1776 is computed at 300,000 down to that year. At the first census, in 1790, the slaves in the United States numbered 697,897, all the states but Massachusetts (which then included Maine) having some servile inhabitants, though Vermont had but 17, and New Hampshire only 158. In 1800 their number was 893,041, slavery having ceased in Vermont, and but 8 slaves being left in New Hampshire. The census of 1810 showed 1,191,364 slaves, there being none in Massachusetts, New Hampshire, Vermont, and Ohio, the last a new state, created out of territory that was a wilderness in 1776.

In 1820 the slaves numbered 1,538,022; in 1830, 2,009,043; in 1840, 2,487,455; in 1850, 3,204,313; and in 1860, 3,953,760.—The feeling in the United States was generally averse to slavery at the time their national existence began, and in some of the southern states that feeling was stronger than it was in most of the northern ones. The ordinance of 1787, excluding it from the N. W. territory, was supported by southern men, and some southern states abolished the slave trade with Africa while northern states continued to carry it on. Vermont abolished slavery in 1777, before she had joined the Union. Pennsylvania in 1780 provided for the gradual emancipation of her slaves, of whom 64 were still living as such in 1840, the relics of her 3,737 in 1790. In Massachusetts the supreme court declared that slavery was abolished by the act of adopting the state constitution of 1780, which had been so framed in one part as to provide for such a decision. Rhode Island gradually emancipated her slaves, and had but 5 left in 1840; and Connecticut did the same, having 17 in that year, and having had 2,759 in 1790. New York adopted a gradual emancipation act in 1799, at which date she had upward of 20,000 slaves; and in 1817 she passed another act declaring all slaves free on the 4th of July, 1827. New Jersey pursued the same course in 1804, her slaves in 1790 numbering 11,423, of whom 236 were living in 1850. That the southern states did not imitate the emancipation policy of those of the northern part of the American Union, is to be attributed to a variety of circumstances, the principal of which were the difference of climate and the difference of social life, which made slavery far more profitable in the south than it could ever be made in the north, where it never flourished, and where in some instances the young of slaves were given away. The invention of the cotton gin made slavery very profitable, and so helped to change that opinion which had existed in the south, both in the colonial and in the revolutionary times, and which, as expressed by such men as Washington, Jefferson, and Patrick Henry, looked to the extinction of slavery. That opinion passed away, and slavery was upheld in the southern states as an institution excellent in itself, and to be in every way promoted and extended, some of its more ardent friends advocating the resumption of the slave trade with Africa. The system of American slavery, unlike that of Greece or of Rome, was based on the alleged inferiority of the African race. The Greeks and the Romans enslaved white men of all races with whom they came in contact. So did the Barbary states, in which, notwithstanding their proximity to the country of the blacks, there were probably as many white as colored slaves. In America the idea of holding white men in slavery was always abhorrent to the most devoted supporters of slavery. But owing to the illicit amalgamation of the white and black races which is a concomitant of slavery, there was no inconsiderable number of American slaves in whom the proportion of African blood was so slight as to be almost or quite imperceptible. The aversion to color was so far shared in the non-slaveholding states, that before the late civil war in only one of their number (Vermont) were negroes entirely the equals of the whites before the law; and socially they were everywhere treated as an inferior caste. —Slavery was opposed by eminent men in the United States from the beginning. Washington, Franklin, Jefferson, Madison, Jay, Hamilton, and many more of those who took a conspicuous part in laying the foundations of the government, regarded slavery as a great evil, inconsistent with the principles of the declaration of independence and the spirit of Christianity. They confidently expected that it would gradually pass away before the advancing power of civilization and freedom; and, shrinking from what they regarded as insurmountable obstacles to emancipation in their own time, they consented, in forming the constitution, to give the system certain advantages which they hoped would be temporary, and therefore not dangerous to the stability of the government. Societies to promote the gradual abolition of slavery were formed in many of the states. The "Pennsylvania Abolition Society," founded in 1775, continued in existence until slavery was destroyed. Its first president was Benjamin Franklin, its first secretary Benjamin Rush. In 1790 it sent a memorial to congress, bearing the official signature of "Benjamin Franklin, president," asking that body to "devise means for removing the inconsistency of slavery from the American people," and to "step to the very verge of its power for discouraging every species of traffic in the persons of our fellow men." The "New York Manumission Society" was formed in 1785, John Jay being the first president, and Alexander Hamilton his successor. Similar associations were formed in Connecticut, Rhode Island, Delaware, Maryland, and Virginia. These societies exerted a strong influence in favor of the abolition of slavery in several northern states. In 1819–'20 the opponents of slavery made a stern resistance to the admission of Missouri to the Union as a slave state, and were defeated. (For particulars on the compromises which ended this and a similar struggle in 1850, and the whole of the political conflicts in regard to slaveholding in the territories of the United States, and the laws regulating the rendition of fugitive slaves, see United States and the notices of the presidents and the principal party leaders, such as Calhoun, Henry Clay, and Stephen A. Douglas.) The Missouri conflict was followed by a period of profound repose in regard to the whole subject. The publication, by Benjamin Lundy, a Quaker, of a small journal at Baltimore entitled "Genius of Universal Emancipation," was almost the

only visible sign of opposition to slavery until William Lloyd Garrison established "The Liberator" in Boston, Jan. 1, 1831. Accepting the definition of American slavery furnished by the statutes of the slave states, which declare the slaves to be "chattels personal, in the hands of their owners and possessors, to all intents, constructions, and purposes whatsoever," he asserted that slaveholding was a sin against God and a crime against humanity; that immediate emancipation was the right of every slave and the duty of every master. On Jan. 1, 1832, the first society on this basis was organized in Boston by 12 men, Arnold Buffum, a Quaker, being president. The "American Anti-Slavery Society" was formed in Philadelphia in December, 1833, Arthur Tappan being its first president. This society and its auxiliaries expressly affirmed that congress had no right to abolish slavery in the slave states, and they asked for no action on the part of the national government that had not, up to that time, been held to be constitutional by leading men of all parties in every portion of the country. They pronounced all laws admitting the right of slavery to be "before God utterly null and void." They declared that their principles led them "to reject, and to entreat the oppressed to reject, the use of all carnal weapons for deliverance from bondage;" their measures, they said, would be "such only as the opposition of moral purity to moral corruption, the destruction of error by the potency of truth, and the abolition of slavery by the spirit of repentance." By means of lectures, newspapers, tracts, public meetings, and petitions to congress, they produced an intense excitement throughout the country, the effects of which were soon manifest in the religious sects and political parties. The American anti-slavery society and those affiliated with it were opposed to the formation of a distinct anti-slavery political party, deeming it wiser to attempt to diffuse their principles among the members of all parties. In 1840, on account of differences upon this and other matters affecting the policy of the movement, a portion of the members seceded and formed the "American and Foreign Anti-Slavery Society." The "liberty party" was organized in the same year, mainly by the seceders and those in sympathy with them. This party was mostly absorbed by the "free-soil party" in the presidential election of 1848, though a small number of persons, holding the opinion that the national government had constitutional power to abolish slavery in every part of the country, continued under the name of liberty party for several years. The free-soil party was in its turn absorbed by the republican party, which in the presidential election of 1856 first exhibited great strength and commanded a popular vote of upward of 1,300,000, though it failed to elect its candidates. In 1860 it elected Abraham Lincoln president and Hannibal Hamlin vice president by the vote of all the free states except New Jersey. In 1844 the American anti-slavery society openly avowed its conviction that the so-called "compromises of the constitution" were immoral; that, consequently, it was wrong to swear to support that instrument, or to hold office or vote under it. From that time until the secession of the slave states, the abolitionists of this school avowed it to be their object to effect a dissolution of the American Union and the organization of a northern republic where no slavery should exist. The "American Abolition Society" was formed in Boston in 1855, to promote the views of those who held that the national government had constitutional power to abolish slavery in every part of the Union. The "Church Anti-Slavery Society" was organized in 1859, for the purpose of convincing the American churches and ministers that slavery was a sin, and inducing them to take the lead in the work of abolition. There have been few slave conspiracies or insurrections in the United States, and the servile population never produced any band of men to be compared with the Maroons of the West Indies, who so long baffled the exertions of the whites to subdue them. It is estimated that more than 30,000 American slaves, after escaping from bondage, found an asylum in Canada. They were aided in their flight by opponents of slavery in the free states. An attempt, in 1859, at subverting the slave institutions of the United States by an insurrection ended in speedy defeat, and was followed by the execution of the leader, John Brown, and some of his associates. The secession of the states which formed the government of the Confederate States in 1861 wholly changed the relations of the government of the United States to the institution of slavery. Although President Lincoln hastened to make strong assurances of the purpose of the government to abide faithfully by all the compromises of the constitution relating to slavery, and in all the military orders endeavored to provide for so conducting the war as to avoid disturbing the relation of master and slave as it then existed under state laws, it soon became evident that a vigorous prosecution of the war must of necessity make serious inroads upon the institution, if not wholly destroy it in those districts which the federal army should occupy. In May, 1861, Maj. Gen. Butler, commanding the department of Eastern Virginia, declared slaves who had been employed for military purposes of the confederacy to be contraband of war, and appropriated them to the purposes of his own army. In August following Gen. Fremont, commanding in Missouri, issued a general order wherein, among other things, he proclaimed free all the slaves of those who should take up arms against the United States, or take active part with their enemies in the field. In the particular specified this order was modified by direction of the president, but slaves who had performed any service for the confederate army, whether as servants

or as day laborers, were in general treated as "contrabands" by all the military leaders. In the annual report of the secretary of war, Dec. 1, 1861, the following passage occurs: "It is already a grave question what shall be done with those slaves who were abandoned by their owners on the advance of our troops into southern territory, as at Beaufort district in South Carolina. The number left within our control at that point is very considerable; and similar cases will probably recur. What shall be done with them? Can we afford to send them forward to their masters, to be by them armed against us, or used in producing supplies to sustain the rebellion? Their labor may be useful to us; withheld from the enemy, it lessens his military resources; and withholding them has no tendency to induce the horrors of insurrection, even in the rebel communities. They constitute a military resource; and being such, that they should not be turned over to the enemy is too plain to discuss. Why deprive him of supplies by a blockade, and voluntarily give him men to produce them?" Nevertheless several of the commanders of Union armies allowed masters to appear within their lines and carry off into slavery fugitives found therein. An order of Gen. David Hunter, commanding the department of the South, dated May 9, 1862, declaring the states of Georgia, Florida, and South Carolina under martial law and the slaves therein free, was annulled by proclamation of the president ten days later. On Aug. 22, 1862, the president in a public telegraphic despatch addressed to Horace Greeley, in response to a letter from that gentleman, gave utterance to his views as follows: "If there be those who would not save the Union unless they could at the same time save slavery, I do not agree with them. If there be those who would not save the Union unless they could at the same time destroy slavery, I do not agree with them. My paramount object is to save the Union, and not either to save or destroy slavery. If I could save the Union without freeing any slave, I would do it; if I could save it by freeing all the slaves, I would do it; and if I could save it by freeing some and leaving others alone, I would also do that. What I do about slavery and the colored race, I do because I believe it helps to save this Union; and what I forbear, I forbear because I do not believe it would help to save the Union. I shall do less whenever I shall believe what I am doing hurts the cause, and I shall do more whenever I believe doing more will help the cause." Meantime, on March 2, 1862, the president had recommended to congress that a resolution be adopted "that the United States, in order to coöperate with any state which may adopt gradual abolition of slavery, give to such state pecuniary aid, to be used by such state in its discretion, to compensate it for the inconvenience, public and private, produced by such change of system." The resolution was adopted, but produced no effect. Immediately after the battle of Antietam the president issued a proclamation (Sept. 22, 1862), in which, after declaring his determination to prosecute the war for the object of practically restoring the constitutional relation between the Union and the several states, and that it was his purpose at the next meeting of congress to recommend some practical measure of assistance in emancipation to those states which would voluntarily accept it, he proceeded to announce that on the first day of January, 1863, all persons held as slaves within any state or designated part of a state, the people whereof should then be in rebellion, should be then, thenceforward, and for ever free, and the executive government, including the military and naval authority thereof, would maintain such freedom. He further proclaimed that on the said first day of January he would by proclamation designate the states and parts of states then in rebellion, but that any state which should then be represented in congress by members chosen thereto at elections wherein a majority of the qualified voters participated, should in the absence of strong countervailing testimony be conclusively deemed not in rebellion. After then calling attention to legislation of congress bearing date March 13, 1862, forbidding the employment of military force to return fugitives to slavery, and that of July 16, 1862, for the confiscation of property of rebels, including slaves, and enjoining the observance thereof, he closed with the assurance that in due time, on the restoration of constitutional relations between the Union and the respective states, he should recommend compensation to loyal persons for all losses, including that of slaves. The final proclamation of freedom was issued on Jan. 1, 1863. It designated the following states and parts of states as then in rebellion: Arkansas, Texas, Louisiana (except the parishes of St. Bernard, Plaquemine, Jefferson, St. John, St. Charles, St. James, Ascension, Assumption, Terre Bonne, Lafourche, St. Mary, St. Martin, and Orleans, including the city of New Orleans), Mississippi, Alabama, Florida, Georgia, South Carolina, North Carolina, and Virginia (except the 48 counties designated as West Virginia, and the counties of Berkeley, Accomac, Northampton, Elizabeth City, York, Princess Anne, and Norfolk, including the cities of Norfolk and Portsmouth). The president enjoined upon the freedmen to abstain from all violence unless in necessary self-defence, and recommended to them in all cases, when allowed to do so, to labor faithfully for reasonable wages; but gave notice also that suitable persons would be received into the armed service of the United States. This proclamation had no very marked effect upon the relation of slavery beyond the lines of the federal army, but it gave consistency and unity to the action of the federal commanders, and it facilitated and hastened the incorporation of freedmen and other colored persons into the federal armies. On June 9, 1862, a law had

been enacted which terminated for ever the long and bitter agitation beginning with the contest about the admission of Missouri to the Union. This declared that "from and after the passage of this act there shall be neither slavery nor involuntary servitude in any of the territories of the United States now existing, or which may at any time hereafter be formed or acquired by the United States, otherwise than in the punishment of crime whereof the party shall have been duly convicted." On June 23, 1864, all laws for the rendition of fugitive slaves to their masters were repealed. On Jan. 31, 1865, the final vote was taken in congress submitting to the states for their approval and ratification the following amendment to the constitution: "Article XIII. Neither slavery nor involuntary servitude, except as a punishment for crime, whereof the party shall have been duly convicted, shall exist within the United States or any place subject to their jurisdiction." On Dec. 18, 1865, the secretary of state issued his proclamation declaring that this amendment had been approved by the legislatures of Illinois, Rhode Island, Michigan, Maryland, New York, West Virginia, Maine, Kansas, Massachusetts, Pennsylvania, Virginia, Ohio, Missouri, Nevada, Indiana, Louisiana, Minnesota, Wisconsin, Vermont, Tennessee, Arkansas, Connecticut, New Hampshire, South Carolina, Alabama, North Carolina, and Georgia—in all, 27 of the 36 states—and was consequently adopted. The assassination of President Lincoln put an end to any very serious thoughts of making provision for compensation for losses of slaves; and the fourteenth amendment to the constitution, ratified by a majority of the states in 1867–'8, absolutely forbade compensation being made either by the United States or by any state. Thus terminated for ever in the United States the system of bondage which had been its chief reproach in the eyes of the world and of its own people; which from the outset had been the principal source of solicitude to its statesmen; and the southern defenders of which finally assailed the life of the nation with a power and persistency from which it barely escaped, after losses and sacrifices such as few peoples in modern times have been called upon to suffer.—The abolition of slavery has rendered the laws of the several states concerning it of little practical interest, but a few points may be mentioned. The slave was a chattel, for an injury to whom the master might recover damages as for an injury to a beast. Nevertheless he was recognized as a person, so far as to be made amenable to the criminal code, and was punishable as such. The master had a power of discipline over him which did not extend to life or limb, and for any excess in punishment he might be criminally responsible, as he might for excessive violence to a child or apprentice. The police laws of the state were at the master's service for disciplinary purposes, and stringent regulations were made in his interest. The slave had no legal family relations, and any that should be voluntarily formed might be changed at the will of the master, by sale or otherwise. Slaves might be emancipated by the master, by deed or will, under state regulations; but in some of the states the laws were adverse to emancipation, and interposed various obstacles. Whatever was acquired by the slave belonged to his master, and it was therefore legally impossible for the slave to purchase his freedom; nevertheless masters frequently received from their slaves sums which they had accumulated by extra services, and gave them freedom in return. The general doctrine of the courts was that the master by voluntarily taking his slave into a free state gave him his freedom, and this rule was supposed to be applicable to the free territories of the United States until the decision of the supreme court in the case of Dred Scott in 1857, which denied the constitutional power of congress to prohibit the holding of persons in slavery in the territories. Near the same time the doctrine that a master might lawfully hold his slaves in passing through the free states found able advocates among lawyers. Slaves were not allowed legal rights in courts, though persons held as slaves but claiming to be free might bring actions to recover their freedom. Slaves might be witnesses for or against each other where crimes were charged, but were not allowed to be witnesses against white persons. In general the teaching of slaves to read and write was prohibited, as tending to render them discontented with their condition. *Prima facie* in slave states all colored persons were slaves. Since the abolition of slavery persons living together as husband and wife, and continuing to do so, have been recognized in law as being legally married; but until they had voluntarily assumed that relation after becoming free, they were at liberty to marry others without incurring legal penalty.—The colonization of emancipated American slaves in Africa was undertaken in 1820, when the colony of Liberia was founded. (See COLONIZATION SOCIETY.) The colony of Sierra Leone was founded by England in 1787, being composed of American slaves who had joined her flag under promises of freedom. (See SIERRA LEONE.)—The following are some of the most important modern works on the subject of slavery: Thomas Clarkson, "History of the Abolition of the Slave Trade" (London, 1808); George Stroud, "Laws relative to Slavery" (Philadelphia, 1827); William Blair, "An Inquiry into the State of Slavery among the Romans" (Edinburgh, 1832); L. M. Child, "Appeal in behalf of that Class of Americans called Africans" (Boston, 1833); Theodore Weld, "American Slavery as It Is" (New York, 1835); William Jay, "A View of the Action of the Federal Government on Slavery" (New York, 1838); David Trumbull, "Cuba, with Notices of Porto Rico and the Slave Trade" (London, 1840); Richard Hildreth, "Despotism in America"

(Boston, 1840); W. Adam, "The Law and Custom of Slavery in British India" (Boston, 1840); William Goodell, "Slavery and Anti-Slavery" (New York, 1843); Wallon, *Histoire de l'esclavage dans l'antiquité* (Paris, 1847); Fuller and Wayland, "Domestic Slavery" (New York, 1847); Copley, "A History of Slavery" (London, 1852); Horace Mann, "Slavery, Letters and Speeches" (Boston, 1851); John Fletcher, "Studies on Slavery" (Natchez, 1852); "The Pro-Slavery Argument" (Charleston, 1853); F. L. Olmsted, "A Journey in the Seaboard Slave States," "A Journey through Texas," "A Journey in the Back Country," and "The Cotton Kingdom" (New York, 1856–'61); the Rev. Albert Barnes, "An Inquiry into the Scriptural Views of Slavery" (Philadelphia, 1855); Theodore Parker, "Trial for the Misdemeanor of a Speech against Kidnapping" (Boston, 1855); the Rev. Nehemiah Adams, "A South Side View of Slavery" (Boston, 1855); George Fitzhugh, "Sociology for the South" (Richmond, 1855); Arthur Helps, "The Spanish Conquest in America, and its Relation to the History of Slavery," &c. (London and New York, 1856–'60); Weston, "Progress of Slavery in the United States" (Washington, 1857); T. R. R. Cobb, "An Inquiry into the Law of Negro Slavery" (Philadelphia and Savannah, 1858); John C. Hurd, "Law of Freedom and Bondage in the United States" (Boston, 1858); J. R. Giddings, "Exiles of Florida" (Columbus, O., 1858); H. R. Helper, "The Impending Crisis of American Slavery" (New York, 1859); A. Gurowski, "Slavery in History" (New York, 1860); Horace Greeley, "The American Conflict" (2 vols., Hartford, 1864–'6); E. M'Pherson, "History of the Rebellion" (Washington, 1865), and "History of Reconstruction" (Washington, 1868); A. H. Stephens, "The War between the States" (2 vols., Philadelphia, 1868–'70); S. J. May, "Recollections of the Anti-Slavery Conflict" (Boston, 1868); and Henry Wilson, "Rise and Fall of the Slave Power in America" (3 vols., Boston, 1871–'6).

**SLAVIC RACE AND LANGUAGES.** The Slavs or Slavi (in the Slavic languages, *Slovene*, *Słowianie*, &c., names now commonly derived from *slovo* or *słowo*, word; hence, "peoples of one tongue") are one of the most numerous and powerful groups of nations of the Indo-European or Aryan race, occupying at present nearly the whole of eastern Europe and parts of northern Asia. They seem to have anciently been included in the names of the Scythians and Sarmatians. Roman writers refer to the Slavs under the name of the Venedi (Winds, Wends), and later writers under that of Serbs, both of which still designate branches of the race. In the most ancient times to which the history of the Slavs as such can be traced, their seats were around and near the Carpathian mountains, whence they spread N. toward the Baltic, W. toward the Elbe and Saale, and finally, after the destruction of the empire of the Huns, S. across the Danube over the territories of modern Turkey and Greece. With this extension the unity of the race ceased, and they split into a number of tribes, separated from each other by political organization and different dialects. The eminent Slavic scholars Dobrovsky, Kopitar, and Schafarik divide the Slavs into the eastern and western or southeastern and northwestern stems. The former of these contains three branches: 1, the Russians, who are subdivided into Russians and Rusniaks or Ruthenians (in W. Russia, E. Galicia, and N. E. Hungary); 2, the Illyrico-Servian branch, comprising the Serbs proper, the Rascians or Hungarian Serbs, the Bosnians, Herzegovinians, Montenegrins, Slavonians, Dalmatians, Croats, and Slovens or Winds; 3, the Bulgarian branch. The western or northwestern stem comprises: 1, the Lechian or Polish branch, to which belong the Poles, the Slavic Silesians, and an isolated tribe in the Prussian province of Pomerania called Kassubs; 2, the Czecho-Slovak branch, which embraces the Bohemians, Moravians, and Slovaks in N. W. Hungary; and 3, the Sorabo-Wendic or Lusatian branch, containing the remnants of the Slavs of N. Germany. A number of Slavic realms have perished in succession, as those of Bohemia, Moravia, and Poland; and at the beginning of the present century only one, Russia, was left, besides which Servia and Montenegro maintain a semi-independent position.—In modern times a Panslavic movement, aiming at a closer union of all Slavic tribes, has arisen and gained considerable political importance. One of the first publicly to advocate it was the Czecho-Slovak poet Kollar, who published an address to all the Slavs, urging them to drop their numerous family feuds, to consider themselves as one great nation, and their related languages essentially as one. The idea was seized upon with eagerness by the Bohemians and other Slavs of Austria, who by a Slavic union hoped to prevent their being absorbed by the German and Hungarian races. It has since gained great strength in Austria by the endeavors of Schafarik, Palacky, Gaj, and other eminent Slavists, and has also found many distinguished advocates in Poland and Russia, in literary as well as in political circles. From a federative union of all Slavs under a democratic form of government to a union under the sceptre of the czar, every possible form of future organization has found advocates, the movement being principally fostered by Russian, and according to circumstances also by Austrian, influence. In the Slavic congress of Prague, assembled in the spring of 1848, the revolutionary element prevailed, leading to a bloody conflict with the Austrian troops under Windischgrätz, and the severe persecution of various members of the congress. The opening of the Austrian provincial diets and central Reichsrath in 1861 was productive of new Panslavic manifestations. An important Panslavic gathering took

place in Moscow on occasion of the ethnographic exhibition opened in May, 1867. The aggregate number of the Slavs was estimated by Schafarik about 35 years ago at about 80,000,000, of whom about 39,000,000 were Russians, 13,000,000 Rusniaks or Ruthenians (in a wider sense, including the Little Russians), 10,000,000 Poles (including Silesians and Kassubs), 4,500,000 Bohemians and Moravians, 3,500,000 Bulgarians, 2,800,000 Slovaks, &c. More recent estimates place the aggregate number of the Slavs nearer to 90,000,000. (See Europe, vol. vi., p. 787.)—The Old or Church Slavic (so called because it is still used in divine service) is the oldest branch of the Slavic languages. The Bible or parts of it were translated into it by Cyril and Methodius in the 9th century, the former of whom also invented an alphabet for it, which was called after him the Cyrillic, and is still used by the Serbs belonging to the Greek church, and in a modified form by the Russians, while the Poles, Bohemians, and others use the Roman alphabet. (See Glagolitic.) The church books written in Old Slavic are still used by the Serbs and Russians. Among the most important documents of this language are old gospels. The oldest works of the Servian and Russian literature, as the works of Nestor, were also written in this language. There is a grammar of it by Miklosich (Vienna, 2d ed., 1854). Formerly this was regarded as the common language of the ancient Slavs and as the mother of all the present Slavic idioms, but modern investigations have clearly shown that it was only their elder sister. Where this idiom was spoken is a controversy not yet settled; but the best authorities favor the claims of Bulgaria, regarding the present Bulgarian as its direct descendant. It is no longer a living tongue, but its treasures are still an inexhaustible mine for its younger sisters. Of the living Slavic languages, the Russian, Polish, Bohemian, and Servian have considerable literature. These languages, as well as their literatures, are treated separately under their respective heads. Among the peculiarities of the Slavic languages are the following. They have three genders. Like the Latin, they have no articles, with the exception of the Bulgarian, which suffixes one to the noun. The nouns, pronouns, and adjectives have seven cases. Some dialects have a dual. The verbs are divided into perfect and imperfect, whose relation to each other is about the same as that of the perfect and imperfect tenses in the conjugation of the Latin verb. All the dialects are comparatively poor in vowels and deficient in diphthongs. There is a great variety of consonants, and especially of sibilants, but no *f* proper is to be found in any genuine Slavic word. Slavic words very seldom begin with *a*, and hardly ever with *e*. The letters *l* and *r* have in some Slavic languages the value of vowels, and words like *twrdy*, *vjtr*, are in metre used as words of two syllables.—The primitive religion of the ancient Slavs seems to have been a kind of monotheism, which gradually passed into polytheism, and lastly into pantheism. Yet the idea of one divine essence was never completely lost, at least among the priests. All Slavs worshipped as their highest god Sviatovist, beside whom the other divinities were accounted as mere demigods. Among these Perun and Radegast received the highest honors. In addition to their gods, they believed in good and evil spirits and demons of different kinds, in the immortality of the soul, and in a retribution after death. Worship was held by their priests in forests and temples, and sacrifices of cattle and fruit were offered. The dead were burned, and their ashes preserved in urns.—See Schafarik, *Slawische Alterthümer* (2 vols., Leipsic, 1843); Talvi, "Historical View of the Languages and Literature of the Slavic Nations" (New York, 1850); Miklosich, *Vergleichende Grammatik der slawischen Sprachen* (Vienna, 1852–'71), and *Beiträge zur Kenntniss der slawischen Volkspoesie* (1870); and Naaké, "Slavonic Fairy Tales" (London, 1874).

**SLAVONIA**, or **Sclavonia** (Hun. *Tótország*), a province of the Austro-Hungarian monarchy, forming with Croatia a kingdom united with that of Hungary, bounded N. and E. by Hungary proper, W. by Croatia, and S. by Turkey; area, inclusive of the recently annexed portions of the former Military Frontier, about 6,600 sq. m.; pop. about 600,000, chiefly belonging to the Greek church. It is divided into the counties of Pozsega, Verőcze, and Szerém (Sirmia). Capital, Eszék. The Danube and the Drave separate Slavonia from Hungary, and the Save from Turkey. A branch of the Carnic Alps traverses its whole length. The mountains abound in coal and marble and in mineral springs, and the forests yield valuable timber. There are many extensive plains covered with vineyards, which produce large quantities of excellent red and white wines. Cattle are largely exported to Cisleithan Austria and Turkey, along with many other products, among which are grain, hemp, flax, tobacco, and silk. The chief manufacture is glass. Among the principal towns are Peterwardein, Carlovitz, and Semlin on the Danube, and Mitrovitz (anc. *Sirmium*), Brod, and Old Gradiska on the Save, all formerly included in the Military Frontier. The inhabitants belong to the Illyrico-Servian branch of the Slavs. (See Servian Language and Literature.)—Under the Romans Slavonia formed part of the province of Pannonia, and was called Pannonia Savia. Later it belonged to the Byzantine empire, until it was occupied by the Avars and Slavs. In the time of Louis le Débonnaire it had its own prince, who submitted to the sovereignty of the Franks. In the 11th century it was incorporated with Hungary. It was conquered by the Turks in 1524, and was formally ceded to them in 1562; but in 1699, by the peace of Carlovitz, it was

retroceded to Austria, resuming also its relation to Hungary. Separated from Hungary in 1849, it was reunited with it in 1867–'8 as a part of the kingdom of Croatia and Slavonia. (See Croatia, and Hungary.)

**SLAVS,** or **Sclaves.** See Slavic Race and Languages.

**SLEEP,** a period of repose in the animal system, in which there is a partial suspension of nervous and muscular activity, necessary for the reparation of the vital powers. In sleep there is more or less complete unconsciousness of external impressions, which may be dissipated by any extraordinary excitement, in this respect differing from the torpor of coma produced by abnormal conditions within the cranium or the action of narcotic poisons. In the deep sleep after extreme fatigue there may possibly be a complete suspension of the activity of the cerebrum and the sensory ganglia; some consider dreams a proof of imperfect sleep, while others maintain that there are always dreams during sleep, though they may not be remembered. The refreshing power of sleep depends on the nutritive renovation effected during its continuance; it is a necessity of the system, and must be periodically indulged in. After 12 to 16 hours of waking a sense of fatigue is experienced under ordinary circumstances, showing that the brain needs rest, and this cannot be shaken off unless by some strong physical or moral stimulus; more sleep is required by the young, and less by the aged, in proportion to the rapidity of waste of the tissues. When the sense of fatigue has reached its maximum, sleep will supervene, even under the most unfavorable circumstances. It may be retarded by uncommon mental concentration, excitement, suspense, or the exercise of a strong will, but always with an exhaustion of nervous power which requires a proportionally long period of repose. Stillness, the absence of light, and monotonous low noises, like the buzzing of insects, the murmur of the wind in the trees, the purling sound of running water, the rippling on a beach, the suppressed hum of a distant town, the droning voice of a dull reader, or the mother's lullaby, promote sleep; gentle movements, like the swinging of a hammock or the rocking of a cradle or boat, are also conducive to sleep; in reading a dull book the eyes wander fatigued from page to page, and the excitement of the mind is not enough to overcome the tendency to sleep. Persons may become so accustomed to continuous loud noises, as in the vicinity of mills, forges, and factories, that they cannot readily fall asleep in their absence. The transition from sleep to the waking state, and *vice versa*, is generally gradual, but sometimes sudden. The fœtus may be said to be in a continued sleep, and the excess of the sleeping over the waking hours prevails during infancy and childhood, or while growth is greater than the decay of the tissues, and this sleep is more profound as well as longer. Persons of plethoric habit, with good appetite and powers of digestion, are usually sound sleepers; the nervous sleep comparatively little; lymphatic, passionless individuals, who vegetate rather than live, are generally long sleepers. The amount of sleep required depends much on constitution and habit, and the smallest sleepers have sometimes been men of the greatest mental activity. Most men require from six to eight hours of sleep daily, and this amount cannot be materially diminished without injury to the health. As a general rule, the amount necessary to refresh the system is in proportion to the amount of bodily and mental exertion of the individual. —In natural sleep, during the repose of the voluntary muscles, the senses, and the perceptive and intellectual faculties, the functions of respiration, circulation, nutrition, secretion, and absorption continue. The respiration and the pulse, however, are both diminished in frequency; and the temperature of the body is somewhat reduced from its usual standard. Hence the chilliness generally felt during a nap in the daytime, and the propriety of throwing some covering over the body during sleep, even in summer, to avoid taking cold; in this state there is also less power of resisting diseases, especially malarious ones. Nothing is so refreshing during sickness, or so conducive to rapid convalescence, as quiet sleep; and few symptoms are more unfavorable than continued sleeplessness. A habitual deficiency of sleep, from excitement or excessive study, produces sooner or later headache, cerebral disturbance, restlessness and feverishness, and, if the warning be not seasonably heeded, a serious impairment of the vital powers. (See Coma, Dream, and Somnambulism.)

**SLEIDAN,** or **Sleidanus, Johann,** a German author, whose real name was Philipson, born at Schleiden, near Cologne, in 1506, died in Strasburg, Oct. 31, 1556. After studying in many universities, he was employed in diplomacy by King Francis I. of France. Having secretly adopted Lutheranism, he went to Strasburg, where in 1542 he was appointed by the Protestant princes historian of the Smalcald league, and by the town council professor of law. Subsequently he conducted negotiations with France and England, and attended the council of Trent as deputy from Strasburg. His reputation rests on his great work entitled *De Statu Religionis et Reipublicæ, Carolo Quinto Cæsare, Commentarii* (1555; best ed., 3 vols., Frankfort, 1785–'6), in 25 books, to which a 26th was added from a manuscript found among his papers. It embraces a history of the reformation from 1517 to 1556, and is remarkable for impartiality and for its simple and elegant Latin. The best English version is that of E. Bohun, with a continuation to 1562, entitled "General History of the Reformation begun in Germany by M. Luther" (fol., London, 1689).

**SLIDELL, John,** an American politician, born in the city of New York in 1793, died in Lon-

don, July 29, 1871. He graduated at Columbia college in 1810 and entered commercial life, but was not successful, and removed to New Orleans, where he became a prominent member of the Louisiana bar, and was United States district attorney from 1829 to 1833. He was frequently elected to the state legislature, and was a representative in congress from 1843 to 1845. In the latter year he was sent as envoy extraordinary and minister plenipotentiary to Mexico. In 1853 he was chosen United States senator for the unexpired term of Senator Soulé, and was afterward reëlected for six years. He was a supporter of the southern rights party, and when Louisiana had passed the ordinance of secession, in January, 1861, he withdrew on Feb. 4 from the senate, after delivering a menacing and defiant speech. In the autumn he was sent as commissioner to France, together with Mr. Mason of Virginia, who was appointed in the same capacity to England. Sailing from Charleston, they ran the blockade, and embarked at Havana on board the English mail steamer Trent. On Nov. 8 Capt. Wilkes, of the United States steam frigate San Jacinto, boarded this vessel, and arrested the commissioners, who were confined in Fort Warren, Boston harbor. But as their capture was informal, they were released on the reclamation of the British government, and on Jan. 2, 1862, sailed for England. Mr. Slidell proceeded to Paris, where through the banker Erlanger (who became his son-in-law) he secured some aid in money and ships for the confederates, and after the close of the war settled in London.

**SLIGO. I.** A county of Ireland, in the province of Connaught, on the N. W. coast, bordering on Leitrim, Roscommon, Mayo, and the Atlantic ocean; area, 721 sq. m.; pop. in 1871, 115,311. The chief towns are Sligo, Dromore, and Tobercurry. The coast line is generally rugged, and is deeply indented by the bays of Sligo and Killala. Sligo bay is about 6 m. wide at the mouth, and extends inland 10 m. to the town of Sligo. The principal rivers are the Sligo, Moy, Arrow, Awinmore, and Easky. Lough Gill, the chief lake, is about 5 m. long and 1½ broad, and is remarkable for the beauty of its scenery. A great deal of the surface is mountainous or boggy. Iron ore is found, and copper and lead mines were formerly worked. Coarse woollens are manufactured. There are many remains of antiquity. **II.** A town, capital of the county, at the head of an arm of the bay of the same name, 107 m. N. W. of Dublin; pop. in 1871, 9,340. It has considerable commerce, but vessels drawing more than 13 ft. are obliged to anchor a mile below the town. In 1870 Sligo was disfranchised as a parliamentary borough.

**SLOANE,** Sir **Hans,** a British naturalist, born at Killyleagh, county Down, Ireland, April 16, 1660, died in Chelsea, near London, Jan. 11, 1753. He studied medicine, natural history, and chemistry in London, where he became acquainted with Ray and Boyle. After a tour on the continent, he settled in 1684 in London, and was soon after elected a fellow of the royal society. In 1687 he accompanied the duke of Albemarle to Jamaica in the capacity of physician, and during a residence of 15 months made large collections of natural curiosities, particularly of plants. Returning to London, he was chosen physician of Christ's hospital in 1694, a post which he filled for 36 years. Being shortly before this time elected secretary of the royal society, he revived the "Philosophical Transactions," and until 1712 was editor of the work. Meanwhile he had formed the nucleus of a comprehensive cabinet of curiosities, which it became one of the chief objects of his life to enrich and enlarge, and which in 1702 received a very considerable augmentation by the bequest of the collection of William Courten. In 1716 he was created a baronet, and was appointed physician general to the army, which office he held till 1727, when he became physician in ordinary to the king. In 1719 he was elected president of the college of physicians, and in 1727 president of the royal society. In 1741 he removed his library and collections to an estate in Chelsea, purchased in 1720, where he spent the rest of his life in retirement. His collections, amounting to 200 volumes of dried plants and over 30,000 other specimens of natural history, besides a library of 50,000 volumes and 3,566 manuscripts, were by the direction of his will offered to the nation for £20,000, less than a quarter of their real value. The legacy was accepted by parliament, and in its purchase originated the British museum. Among many important benevolent schemes he was engaged in the establishment of a dispensary for providing the poor with medical services and medicines, and of the foundling hospital. He also presented the apothecaries' company with the freehold of their botanic garden, which formed part of his estate at Chelsea. His writings comprise "The Natural History of Jamaica" (2 vols. fol., 1707-'25), a Latin catalogue of the plants of Jamaica, a treatise on sore eyes (once highly esteemed), and contributions to the "Philosophical Transactions." He aided in the introduction of the use of Peruvian bark and other new remedies, and gave a considerable impulse to the practice of inoculation by performing that operation on several of the royal family.

**SLOE** (A. S. *sla*), a wild plum, *prunus spinosa*, native in Europe and Russian and central Asia, and sparingly naturalized in the New England and some others of the older states. It is a shrub or low tree, with its smaller branches ending in sharp thorns, which, with the blackish color of the bark, give it the name of blackthorn by which it is frequently called in England; the leaves are ovate or oblong; the small, white flowers are succeeded by a small, globular, black fruit, with a fine bloom; stone turgid; pulp greenish and astringent.

As stated under PLUM, this is thought to be the original of all the cultivated European varieties of that fruit. The sloe is sometimes used as a hedge plant in Europe, and is planted

Sloe or Blackthorn (Prunus spinosa).

around trees in parks to protect them while young from injury by animals; it is sometimes seen in this country in collections of shrubs, its chief merit as an ornament being its early flowering. The wood is hard, heavy, and dark-colored, takes a fine polish, and is used for handles to tools, flails, teeth to rakes, and the like; upright shoots make favorite walking sticks. The leaves when dried are regarded as more like tea than any other substitute; they were at one time largely collected for the adulteration of tea in England, but this is now forbidden under a heavy penalty. The fruit when mellowed by frost is eaten in some parts of Europe, and is made into a conserve; its expressed juice is used in Germany to mark clothing, it being nearly indelible, and in England it forms the basis of "British port."

**SLOTH**, the name of the edentate mammals of the family *tardigrada* (Ill.) and genus *bradypus* (Linn.); both the family and generic names are derived from the extreme slowness of the gait; it is *le paresseux* of the French. The skull is small, rounded, flat, and truncated in front; the jaws very short and the face very little projecting beyond the line of the cranium; the malar bone gives off a zygomatic process which runs backward and passes above the corresponding one of the temporal bone without touching it, a second process descending outside the lower jaw, which is very strong. The fore legs are much longer than the hind, and all the toes end in long curved claws, channelled underneath, the bones firmly united together and the claws naturally turned in against the soles; the fore feet have either three or two toes, and the hind feet three toes; the latter are articulated obliquely on the leg, so that only the exterior edge touches the ground, of course making progression on a level surface very awkward; the pelvis is so wide and the thighs so laterally directed that the knees cannot be brought together. The ears are very short, and concealed under the hair, which is dry, harsh, and coarse. The axillary and iliac arteries, instead of pursuing their usual course down the limbs as single vessels, suddenly subdivide into from 40 to 60 small trunks of equal size, freely anastomosing with each other, looking somewhat like a mass of varicose veins, and distributed chiefly to the muscles; the arrest of the circulation by pressure on a single trunk is thus prevented, and its retardation permits slow and long continued contraction of the muscles of the arms and legs. The stomach is divided into four cavities without folds, the intestine is short, and the cæcum absent; the mammæ are two, and pectoral; there is a common cloaca, as in birds, for the expulsion of the urine and fæces. The dental formula is $\frac{5}{4}-\frac{5}{4}$, the teeth being simple, separated, nearly cylindrical, without roots, with an undivided hollow base continually growing as they are worn by use, and composed of dentine and cement without enamel; there are no incisors; the anterior molars are very small in the three-toed sloth, but in the two-toed are long, pointed, resembling canines, and the lower placed behind the upper. The tail is very short, or absent. The sloths were considered by the early naturalists as imperfect and deformed creatures; but in the trees, their natural home, their peculiarities of structure are as admirably adapted for their convenience and enjoyment as in any other animal; the fore limbs have great freedom of motion, and all are so constructed that by means of the claws they suspend themselves to the branches and hang for a long time, and even sleep, back downward. They are rarely seen on the ground, for the reason that they can pass from one tree to another by the interlocking branches for miles in the thick forests of South America, which they inhabit from Guiana to Paraguay, some species extending to Peru, and according to some authors into Central America. They are rarely more than 2 ft. long, and their hair resembles in color the bark of the trees upon which they live; the food is entirely vegetable, the leaves and twigs of trees. They have one young one at a time, which clings to the mother's back, hiding among the hair; the native name is *ai*, from their feeble plaintive cry; they are remarkably tenacious of life, and apparently unconscious of pain.—Linnæus gave the name of *B. tridactylus* to a three-toed sloth, under the impression that there was only one species thus characterized, whereas Wagner describes several in the *Archiv für Naturgeschichte* for 1850. The animal referred to by Linnæus is grayish, with the body 14 in. long, the head about 3, the tail 1, the fore limb 11, the hind 6, and the claws 2 to 2½; it has 9 cervical vertebræ, and 14 ribs on each side, of which 9 are true; the thumb and little finger are rudimentary and hidden under the skin; there is a ru-

dimentary clavicle attached to the acromion; the hair is reversed on the forearm. It has been calculated that it can take only 50 steps a day, consuming a month in traversing a mile;

Three-toed Sloth (Bradypus tridactylus).

if by chance it ascends a tree too remote from another to admit of a passage across, the natives say that it rolls itself in a ball and drops to the ground, and the thick wiry hair would render such a fall comparatively harmless; from its habits it can rarely if ever drink; its flesh and skin are useless; in captivity it is exceedingly stupid and uninteresting. The unau or two-toed sloth (*B. didactylus*, Linn.; genus

Unau or Two-toed Sloth (Bradypus didactylus).

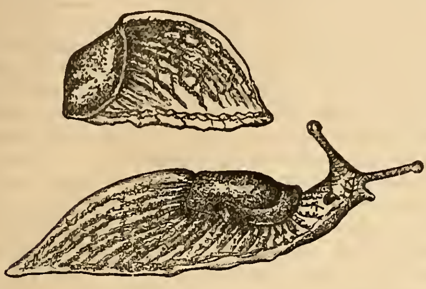
*cholœpus*, Illig.) is mixed brown and white, paler below; it is about 2 ft. long, with, according to Daubenton, 23 ribs on each side, of which 12 are true; the clavicles are complete, and the tail is wanting; it has a longer muzzle and shorter fore legs than the three-toed species, and is more active, especially at night; it inhabits the same region, and is sometimes eaten by Indians and negroes.—For the fossil edentates, see MEGALONYX, MEGATHERIUM, and MYLODON; for anatomical details, see COMPARATIVE ANATOMY, and EDENTATA.

**SLOVAKS**, a Slavic people, belonging to the western stem of the race, and inhabiting chiefly the mountainous regions of N. W. Hungary and the adjoining portions of Moravia. Their number is estimated at nearly 3,000,000, more than two thirds of whom are Catholics, and the remainder Lutherans. They are of medium stature, have blue eyes, straight and long hair, a yellowish skin, and generally coarse features. They are chiefly engaged in agriculture and mining. Numbers of them spend their lives wandering through various countries of Europe, selling linen, mouse traps, and other articles of wire work. The language of the Slovaks is a sub-dialect of the Bohemian or Czech, which latter is generally used by them as a literary medium, as by Kollar, Schafarik, Holly, and other writers, and is also the language of their church services.—The Slovaks occupied their present abodes early in the middle ages, and in the 9th century they formed the nucleus of the Moravian empire until its destruction by the Magyars.

**SLOVENS**, or **Sloventzi**. See WINDS.

**SLUG** (*limax*, Lam.), a genus of mollusks, belonging to the air-breathing gasteropods. The form is elongated, tapering, snail-like, the head having two long and two short tentacles which can be extended and drawn in like the finger of a glove by being turned inside and out; the naked body is covered anteriorly by a coriaceous mantle, under which is the branchial cavity, the respiratory orifice and vent opening on the right side of it, and the generative orifice beneath the right tentacles; the mantle in some contains a calcareous grit, and in others a small, thin, nail-like shell; the head can be partly drawn under the mantle; at the posterior end of the body is a small aperture whence proceed the adhesive threads by which they let themselves down from plants which they ascend in search of food. Their motion is proverbially slow, and effected by the contractions of the flat disk or foot on the ventral surface. The upper jaw is in the form of a toothed crescent, by which they gnaw plants with great voracity; the stomach is elongated; the skin secretes a great quantity of mucosity, which serves to attach them to the surfaces on which they creep; the eyes are small black disks at the end of the posterior tentacles; the sense of touch is delicate. The reproductive season is in spring and summer; they are hermaphrodite, and mutually impregnate each other; the eggs, to the number of 700 or 800, are laid in moist and shady places; at the approach of winter they burrow into the ground, where they hibernate; they hide under decaying logs and stones in damp places, and are seen in gardens and orchards in evening and early morning, especially after gentle and warm showers. They are found in the northern temperate zones of both hemispheres. The common slug of New England, *L. tunicata* (Gould), is nearly an inch long, varying in color from dark drab to blackish brown; the

back is wrinkled, and the upper tentacles granulated and black at the tips; the foot is very narrow; it is found almost always with the isopod crustaceans commonly called sow bugs. Other species are described; they are comparatively rare in the United States, and by no means so troublesome as in Europe. The common European slug, *L. agrestis* (Linn.), is small and unspotted, and very abundant and destruc-



Slug (Limax agrestis).

tive; they are killed by solutions of tobacco, salt, or other irritants, or by covering a spot infested by them with ashes, lime, fine sand, or any powder which attaches itself to the body and prevents their walking, or they may be arrested by some sticky substance; many are devoured by mammals, birds, and reptiles.

**SLUG WORM**, the common name of the larvæ of the sawflies, or the hymenopterous insects of the family *tenthredinidæ*. The slug worm described by Prof. Peck in his prize essay (Boston, 1799), and called by him *tenthredo cerasi* (Linn.), has been placed by Harris in the genus *selandria* (*blennocampa*). The fly is black, with the first pair of legs yellowish clay-colored; the body of the female is about a fifth of an inch long, that of the male a little smaller. They usually appear in Massachusetts on the cherry and plum trees toward the end of May, disappearing in three weeks after laying their eggs singly in incisions on the lower surface of the leaves; the young are hatched in two weeks, coming out from June 5 to July 20, according to season; they have 20 short legs, a pair under every segment except the fourth and the last, and are half an inch long when fully grown; in form they resemble small tadpoles, and are covered with a thick slimy matter which has given them the name of slugs; they also emit a disagreeable odor. They come to their full size in 26 days, casting their skin five times, after which they enter the ground, change to chrysalids, and come out flies in 16 days; they then lay eggs for a second brood, which enter the ground in autumn, and appear as flies in the ensuing spring, some remaining unchanged for a year longer. They feed on leaves, and in some seasons have been so numerous as to strip trees entirely of their foliage and even cause their destruction; they are eaten by small mammals and birds, and the eggs are destroyed by the larvæ of a tiny ichneumon fly (*encyrtus*). The trees may be best preserved against their attacks by showering them with a mixture of whale-oil soap and water, or powdering with ashes or quicklime.

**SMALCALD** (Ger. *Schmalkalden*), a town of Prussia, in the province of Hesse-Nassau (before 1866 of Hesse-Cassel), 34 m. E. N. E. of Fulda; pop. in 1871, 5,792. It manufactures iron, steel, and salt.—The Smalcald league was concluded here in 1531, by various Protestant princes and free cities, for mutual defence of their religious and political independence against Charles V. and the Catholic states of the empire. It was limited at first to six years, but in 1535 new members were admitted at a second convention in Smalcald, and the term was extended ten years, with a resolution to maintain an army of 12,000 men. The elector John Frederick of Saxony and the landgrave Philip of Hesse became the leaders of the league, whose war against the emperor (1546-'7) was terminated by the victory of the latter at Mühlberg, April 24, 1547. In 1537 a confession of faith was drawn up in several articles by Luther, known subsequently as the "Articles of Smalcald," which became one of the symbolical books of the Lutheran church.

**SMALLPOX** (*variola*), a contagious fever, characterized by a pustular eruption having a depressed centre. The terms *variola* and *pacce* first occur in the Bertinian chronicle of the date 961. Variola is derived from the Latin *varus*, a blotch or pimple, while pox is of Saxon origin and signifies a bag or pouch; the prefix small was added in the 15th century. The era commonly assigned for the first appearance of smallpox is A. D. 569; it seems then to have begun in Arabia, and the raising of the siege of Mecca by an Abyssinian army is attributed to the ravages made by smallpox among the troops. The new part which Arabia under Mohammed and his followers was made to play in history contributed to the rapid propagation of the disease throughout the world. Rhazes, an Arabian physician who practised at Bagdad about the beginning of the 10th century, is the first medical author whose writings have come down to us who treats expressly of the disease; he however quotes several of his predecessors, one of whom is believed to have flourished about the year of the Hegira, A. D. 622. Measles and scarlet fever were at first confounded with smallpox, or considered as varieties of it; and this error seems to have prevailed more or less until Sydenham finally showed the essential differences between them. Boerhaave was the first to insist that contagion is essential to the propagation of the disease.—The period of incubation, that is, the time that elapses from the moment the patient receives the contagion until it begins to manifest its effect in the initiatory fever, is usually 14 days, though it sometimes varies. During this time there is usually no disturbance of the ordinary health.

The invasion of the disease is announced by chills followed by fever; this is apt to be attended with pain in the back, particularly in the loins, and with nausea and vomiting. If the fever runs high, with violent pain in the back and much delirium, the disease commonly assumes a severe form. In children the invasion is often announced by an attack of convulsions. The eruption begins to show itself on the third day of the fever. As a rule, it appears first on the face, then on the neck and wrists, then on the trunk, and finally on the extremities. On the fifth day the eruption is complete, and after this few or no new spots appear. It at first consists of minute rounded papules or pimples of a characteristic solid consistency, feeling like small shot beneath the skin. It is by this peculiar solidity of the spots that smallpox at this period is distinguished from other papular eruptions. By the fourth day from their first appearance the papules are converted into vesicles filled with a thin lymph and having a depressed centre, whence they are termed umbilicated. The vesicles begin now to be surrounded by an areola, or circular flush upon the skin, which soon becomes dark crimson; the lymph, at first colorless and transparent, is gradually converted into pus, which increases in quantity and distends the vesicles until they become hemispherical. About the eighth day of the eruption a dark spot makes its appearance at the centre of the pustule, and gradually dries up and is converted into a scab. When this scab falls it leaves either an indelible cicatrix or a purplish red mark which fades very slowly, and which long exposure to a cool atmosphere renders very distinct. In passing away, the eruption follows the course which it took on its first appearance, the scabs first falling from the face, then from the trunk, and last from the extremities.—When the pustules are comparatively few, they are separated, sometimes widely, from each other, and the disease is termed discrete (*variola discreta*); when they are very numerous, they touch each other and run together, and then it is termed confluent (*variola confluens*); and between the two a third variety, the semi-confluent or coherent, is often spoken of. In the discrete form the fever commonly subsides on the appearance of the eruption, and when the pustules are few it may not return; but where they are at all numerous, their maturation is commonly attended with more or less fever. With the appearance of the eruption on the surface, more or less sore throat is complained of; the fauces and tonsils are red and swollen, and pustules make their appearance upon them, upon the roof of the mouth, and the inside of the cheeks; the patient at the same time is commonly troubled with salivation. When smallpox is confluent, the subcutaneous cellular tissue seems involved in the disease, the swelling is very great, and by the fifth day the patient is commonly unable to open his eyes. The eruption on the face sometimes coalesces into one huge sore; it is attended with a tormenting itching, and the fever is of the typhoid kind, the debility being extreme, and the patient restless, sleepless, and often delirious, while the pulse is small, frequent, and feeble. In such cases the accompanying inflammation of the mouth, nasal passages, pharynx, and larynx adds greatly to the distress of the patient and the danger of the disease, sometimes even producing suffocation. The disease is always attended by a peculiar odor, but in confluent cases this is nauseous and offensive to an excessive degree. In this form the fever, which commonly abates on the coming out of the eruption, is aggravated as the eruption approaches maturation. The eighth day of the eruption or the eleventh of the disease is commonly the most fatal day, while more patients die during the second week of the disease than either earlier or later. A second attack, even after free exposure to the contagion, is very rare. Only widely separated instances have been known.—When patients recover from severe attacks of smallpox, blindness from an intercurrent inflammation of the conjunctiva is an occasional result, and before the general introduction of vaccination blindness from smallpox was common. Besides inflammation of the eyes, glandular swellings and abscesses, bed sores, and phlebitis are occasional complications. It is also sometimes complicated with a diseased condition of the blood, producing hæmorrhage from various organs, together with petechiæ. These cases are always attended with great debility; the accompanying fever is typhoid, and the eruption itself does not come out freely. They are almost invariably fatal. Pregnancy is a serious complication. Abortion or premature delivery with the death of the child is commonly produced, but the mother frequently recovers. Sometimes the child presents the characteristic eruption of the disease, but this is rare. Still more rarely a mother whose system has been protected by vaccination or a previous attack of the disease, communicates it, after exposure, to the *fœtus in utero*, while she herself escapes. Confluent smallpox is always dangerous, and the danger is aggravated if the patient be still in infancy or over 45 years of age, or of a feeble or strumous constitution.—The mortality from smallpox is estimated at one fourth or one fifth of all who are attacked; that of the London smallpox hospital has long averaged 30 per cent. Like many other contagious diseases, it is subject to epidemic influence, and when it prevails epidemically it seems to be severer and more fatal. It is remarkable that when it is communicated by a minute portion of the virus being inserted under the cuticle by inoculation, as it is termed, the disease is far less violent than if communicated through the atmosphere; and yet a second attack in such a case is as improbable as in any other. When patients are inoculated the mortality is rarely greater than 1 in 600 or 700. Inoculation was

introduced into civilized Europe from Constantinople through the sense and courage of Lady Mary Wortley Montagu, but since the discovery of vaccination by Dr. Jenner has been discontinued. (See VACCINATION.)—For a long time the dangers of smallpox were aggravated by the means used for its cure; in accordance with the theories of the time, which still have their influence among the vulgar, the eruption was looked upon as an effort made by nature to free the system of morbid matter; the more abundant it was, the better for the patient. The eruption was accordingly encouraged by warm drinks and a heated atmosphere. Sydenham was the first to inculcate the necessity of free ventilation and a cooling regimen. Mild cases require little except attention to hygienic measures; the disease is attended with little danger, and should run its course uninfluenced by art. When it is severe, attention should be early directed to supporting the strength of the patient. The diet should be as nutritious as he can bear, and, when indicated by the pulse, wine and stimulants should be freely administered. The troublesome itching, which causes great suffering, may be alleviated by the application of sweet oil, cold cream, or lard; opiates may be useful to procure sleep, and the bowels should be occasionally moved by mild laxatives or enemata.

**SMART, Christopher**, an English author, born at Shipborne, Kent, April 11, 1722, died in the king's bench prison, London, May 18, 1770. He was educated at Cambridge, and elected a fellow of Pembroke hall in 1745, and gained the Seatonian prize for poems on the Supreme Being for five years consecutively. In 1753 he married, removed to London, and supported himself by writing. Through intemperance and extreme poverty he lost his reason, and was confined in a lunatic asylum for two years. He made a prose translation of Horace, and metrical versions of Horace and Phædrus, and of the Psalms. Among his other works is "The Hilliad, an Epic Poem," a satire on Sir John Hill, who had criticised him. In 1752 he published a collection of his poems. A posthumous edition appeared in 1791 with a memoir (2 vols. 12mo). His Horace has had several editions in the present century.

**SMART, John.** See p. 890.

**SMARTWEED.** See POLYGONUM.

**SMEATON, John**, an English civil engineer, born at Austhorpe, near Leeds, May 28, 1724, died there, Oct. 28, 1792. Before his 15th year he had made mechanical inventions and discoveries. In 1750 he became a mathematical instrument maker, and in 1751 invented a machine for measuring a ship's way at sea. He made valuable improvements in hydraulic machinery, and in 1759 read a paper on this subject before the royal society, for which he received the Copley gold medal. The Eddystone lighthouse being destroyed by fire in 1755, Smeaton rebuilt it. (See LIGHTHOUSE.) He afterward built canals and locks on the Derwentwater estate, constructed the great canal from the Forth to the Clyde, improved the Calder navigation, supplied Greenwich and Deptford with water, erected the Spurn lighthouse, preserved the old London bridge, and erected several bridges in Scotland. About 1783 he withdrew from business. He published a volume on the Eddystone lighthouse (1791), and his professional reports were published by the institution of civil engineers (3 vols. 4to, 1812-'14).—See Smiles's "Lives of the Engineers."

**SMELL**, the special sense by which we take cognizance of the odoriferous qualities of foreign bodies. The main peculiarity of this sense is that it gives us intelligence of the physical properties of substances in a gaseous or vaporous condition. An odoriferous body gives off emanations which diffuse themselves through the atmosphere, and we thus perceive its existence at a distance and when it may be concealed from sight. The actual quantity of vaporous material necessary for making an impression upon the olfactory organ is very small; and a substance like musk or attar of roses may fill an entire apartment or even a house for days or weeks with its peculiar odor, readily perceptible by all the occupants, without suffering any appreciable loss of weight.—The organ of smell is the mucous membrane of the upper part of the nasal passages, supplied by the filaments of the olfactory or first pair of cranial nerves. These nerves are endowed with the special sense of smell, but are destitute of ordinary or general sensibility. Thus they can perceive the odors of foreign substances, but not the physical contact of a solid body. On the other hand, the lower portion of the nasal passages is supplied by filaments from the fifth pair of cranial nerves, which are nerves of general sensibility, but not susceptible to the impression of odors. Not all vapors are odoriferous; some are simply irritating or stimulating to the mucous membrane. The odors proper are generally of an organic origin, such as those of musk, asafœtida, the leaves and blossoms of plants, and the exhalations of living or decomposing animal bodies. Other gaseous emanations are simply irritating, like those of ammonia, chlorine, and acetic acid. Sometimes the two kinds of exhalations are mingled; thus pure alcohol is nearly or quite destitute of odor, but in cologne water we have the stimulating properties of the alcohol, mingled with odoriferous ingredients of a vegetable origin. Ammonia is irritating to the mucous membrane of the nose for the same reason that it is irritating to the skin when brought in contact with it; but the skin is incapable of perceiving a true odor. The dissemination of odors is favored by the movement of the atmosphere; and when a disagreeable or noxious odor is contained in the air of an apartment, a free ventilation is the readiest method of expelling it. When we wish to perceive more distinctly a

faint or a delicate odor, we direct the air forcibly upward, by a peculiar inspiratory effort of the nostrils, through the superior part of the nasal passages. This movement is especially observable in many of the inferior animals, in whom the sense of smell is remarkably acute, and the olfactory mucous membrane unusually extensive and sensible. The dog, for instance, will not only distinguish different kinds of animals by their odor, but will recognize different individuals of the human species, or particular articles of dress belonging to them. He will even follow the track of wild game by the minute quantity of animal odor left by their footsteps upon the grass or dried leaves.—The sense of smell, like the other senses, becomes habituated to particular impressions when long continued; even disagreeable odors gradually lose in this way their offensiveness, and we become after a time more or less insensible to their presence. A disagreeable odor is not invariably injurious in itself; but it is almost always the indication or accompaniment of a gaseous emanation which is in reality noxious, or will become so if allowed to accumulate. The offensive odor is a warning to the senses that the atmosphere is no longer pure and should be renovated; and if this warning be neglected, it at last ceases to make itself felt, and the exhalations may then imperceptibly increase until they produce serious injury.

**SMELT,** a soft-rayed fish of the salmon family, and genus *osmerus* (Artedi). The body is elongated and covered with small scales; there are two dorsals, the first with rays and the second adipose and rayless; ventrals under the anterior rays of dorsal; teeth on the jaws and tongue very long, and on the premaxillaries small and hooked; gill openings wide; air bladder silvery within. The common American smelt (*O. viridescens*, Les.) is about 10 in. long; the upper parts with the dorsal and caudal fins are yellowish green with coppery reflections, with very minute black dots; sides silvery white; abdomen and lower fins milky white; gill covers golden. It is found from

American Smelt (Osmerus viridescens).

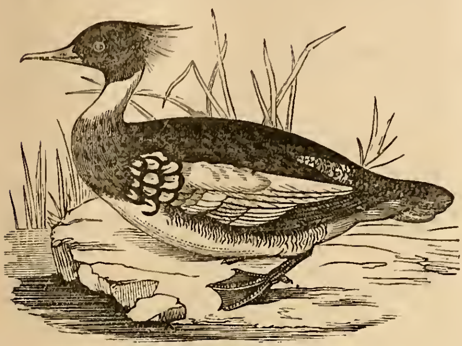
New York to Labrador, going up rivers in early spring and returning to the sea late in autumn, at which times immense quantities are taken by hook and nets; the flavor is very delicate. They bear transfer from salt into fresh water, and have become permanent residents in Champlain, Squam, and Winnipiseogee lakes, and in Jamaica pond near Boston; these are smaller and more slender than the marine smelt. The European smelt (*O. eperlanus*, Art.) is from 7 to 9 in. long, lighter colored above, with thicker body and narrower head. They are found in all the rivers opening into northern seas; they are the *éperlans* of the French and the spirling or sparling of the English; when recently taken from the water, they have a sweetish, not disagreeable, and cucumber-like odor, from which the generic and the common names are derived. Smelts eat small fish, crustaceans, and mollusks.

**SMELTING.** See Copper Smelting, Iron Manufacture, Lead, and Silver.

**SMET, Peter John de,** an American missionary, born in Dendermonde, Belgium, Dec. 31, 1801, died in St. Louis, May 23, 1873. He arrived in Philadelphia in August, 1821, entered the Jesuit novitiate at Whitemarsh, Md., went to Missouri in 1823, and aided in founding the university of St. Louis, in which he labored till 1838, when he was sent to found a mission among the Pottawattamies. His success caused him to be sent to the Flatheads in 1840, and to the Blackfeet soon afterward. He then planned a regular system of missionary establishments, which were taken charge of by his brother Jesuits, reserving to himself a general superintendence over them and the duty of providing funds for their support. He published several papers in the United States and in Europe for the purpose of creating public interest in favor of these missions, repeatedly visited Belgium and other Catholic countries to collect alms and obtain missionaries, and established several new missionary centres on both sides of the Rocky mountains. During a last voyage undertaken for the missions he sustained injuries which resulted in his death. His principal works are: "Letters and Sketches, and Residence in the Rocky Mountains" (Philadelphia, 1843); "Oregon Missions, and Travels over the Rocky Mountains" (New York, 1847); "Western Missions and Missionaries" and "New Indian Sketches" (New York, 1863); and *Reisen zu den Felsengebirgen und ein Jahr unter den wilden Indianerstämmen des Oregon-Gebietes* (St. Louis, 1865).

**SMEW** (*mergellus albellus*, Selby), a web-footed bird differing from the typical mergansers, to which subfamily it belongs, in having the bill much shorter than the head and elevated at the base, and the mandibles with short and closely set lamellæ. It is about 17½ in. long and 27 in. in alar extent; the general color is white, whence its common name of white nun; around the eyes, a patch on each side of the nape, semi-collar on each side of lower neck, middle of back, tail, and wings black; scapulars, middle wing coverts, tertials, and secondary tips white; in the female the head is reddish brown. It is found in the northern parts of the old world, in winter coming down to central Europe, frequenting the sea coast, lakes, and rivers; it is an expert swimmer and diver, and feeds on fish and crustaceans; the nest is made near the water,

and the eggs are 8 to 12; like other mergansers it hybridizes with the ducks, especially with the genus *clangula* (Flem.). It is generally



Smew (Mergellus albellus).

believed to be accidental in America, only a single female specimen having been obtained by Audubon, near New Orleans.

**SMIBERT, or Smybert, John,** a Scottish painter, born in Edinburgh about 1684, died in Boston, Mass., in 1751. He studied in Italy for three years, and attained a respectable standing as a portrait painter in London. In 1728 he accompanied Dean Berkeley to America, after whose return he settled in Boston. He painted most of the contemporary worthies of New England and New York. His most celebrated picture is a large portrait piece representing Berkeley and several members of his family, together with the artist himself, on their first landing in America. It is now in the possession of Yale college.

**SMILAX,** a genus of endogenous, mostly shrubby, often prickly plants, which climb by tendrils. They are abundant in warm climates, and are represented in the Atlantic states by several species, some of which are popularly known as greenbrier, catbrier, or brier. The genus is the only one in the flora of the northernmost states which affords an example of a woody endogenous stem; the general aspect of the plants is that of the exogens, as their leaves are netted-veined, while in the great majority of endogens they are parallel-veined; the petioles are furnished with a tendril upon each side. The flowers, in axillary umbels, are small, diœcious, with the greenish or yellowish regular perianth in six parts; the sterile flower has six stamens; the fertile has a free ovary of three or more cells and as many thick and spreading stigmas; fruit a small berry with one to three seeds. The best known species is the common greenbrier (*smilax rotundifolia*), which extends from Canada through the southern states; it often forms, by spreading over the shrubs and trees, impenetrable thickets, its stems extending from one tree to another for 30 or 40 ft., and very slender and strong; the smooth leaves are nearly orbicular, often broader than long, and somewhat heart-shaped at base, of a pleasing soft green color, which turns to deep yellow in autumn, and later to a rusty brown, though in the southern states they are nearly evergreen; the small clusters of berries are black, with a bloom, and have a tempting appearance, but are very nauseous to the taste. The plant is variable, and forms of it have been described as distinct species. It is a handsome ornamental climber, which has received no attention because it is common. There are about a dozen other species, from New Jersey southward, with variously shaped leaves, some of them evergreen, and differing in their fruit clusters. The most important of these is popularly known in the southern states as China brier (*S. pseudo-China*), which extends northward to New Jersey; its stems, especially near the base, have weak blackish prickles; the leaves are ovate heart-shaped, often with a fringe of rough hairs on the margins and a

Greenbrier (Smilax rotundifolia).

slender point. The young and tender shoots of this are eaten as asparagus; the mature stems have a reputation as an alterative; the rootstocks, which are tuberous, brownish red, and sometimes as large as the two fists, contain considerable starch, which the Seminoles formerly used in times of scarcity, both by separating the starch and by cooking the whole root; a kind of beer has been made from them, with molasses, parched corn, and sassafras; the root is light, porous, easily worked, and is largely used for tobacco pipes. A few species are herbaceous, the most common being the variable *S. herbacea*, 1 to 6 ft. high, with mostly heart-shaped leaves; the flowers are in large umbels, upon stalks 3 to 8 in. long, the fertile ones succeeded by a showy, nearly globular cluster of berries. This is sometimes a troublesome weed in pastures; when in bloom its presence is readily detected from the odor of its flowers, which has given the plant the well merited name of carrion flower. Two

other species belong to this section, which Torrey at one time regarded as a distinct genus, to which he gave the appropriate name of *coprosmanthus*. Nearly 200 species of *smilax* are enumerated as growing in various parts of the world, but, judging from the confusion of names existing among our own, the number of real species is much less. The most important exotic species are those which furnish the drug sarsaparilla. (See SARSAPARILLA.) Another medicinal product is the China root, the rhizome of *S. China* and several other eastern species, which, under the name of *radix Chinæ*, came into use about A. D. 1535 as a remedy for syphilis, gout, and rheumatism; it is now little used except in the East. The fresh rootstocks of this and other species are cooked and eaten by the Chinese.—Under the name of smilax florists cultivate in greenhouses large quantities of *myrsiphyllum asparagoides*, a liliaceous plant from the Cape of Good Hope, closely allied to asparagus; it has small tuberous roots, and very slender, strong, branching stems, which climb by twining to the height of 20 ft. or more; its proper leaves are minute scales, from the axils of which, as in asparagus, appear small branches, so modified that they look like true leaves, the functions of which they perform; the flowers are small, whitish, and inconspicuous, and are followed by green berries about the size of those of asparagus. It is raised from seeds, the roots being kept from year to year. This plant is one of the most valuable and popular of all greens used for decorations, as it does not readily fade, and its thread-like stems allow it to be used in the most delicate work. It is a very useful window plant if the atmosphere of the room is not excessively dry.

Smilax Vine (Myrsiphyllum asparagoides).

**SMILES, Samuel,** a British author, born at Haddington, Scotland, in 1816. After practising as a surgeon for some time at Leeds, he became editor of the Leeds "Times" in 1845, secretary of the Leeds and Thirsk railway, and in 1852 secretary of the Southeastern railway, from which post he retired in 1866. He has published "Physical Education, or Nature of Children" (Edinburgh, 1837); "History of Ireland and the Irish People under the Government of England" (London, 1844); "Life of George Stephenson" (1857); "Self-Help, with Illustrations of Character and Conduct" (1859); "Brief Biographies" (Boston, 1860); "Workmen's Earnings, Strikes, and Savings" (London, 1861); "Lives of the Engineers, with an Account of their Principal Works" (4 vols. 8vo, 1861–'5; new ed., 5 vols., 1875, including Stephenson); "Industrial Biography" (1863); "The Huguenots, their Settlements, Churches, and Industries in England and Ireland" (1867); "Character," a companion volume to "Self-Help" (1871); "The Huguenots in France after the Revocation of the Edict of Nantes" (1874); and "Thrift" (1875).

**SMILLIE, James, James D., and George H.** See p. 891.

**SMIRKE. I. Sir Robert,** an English architect, born in London in 1780, died at Cheltenham, April 18, 1867. He was the oldest son of Robert Smirke, a popular genre painter. After a tour through Germany and southern Europe, he settled in London in 1805 as an architect. He brought himself early into notice by his design for Covent Garden theatre (1808–'9), which was destroyed by fire in March, 1856. Subsequently he was employed in designing many public buildings in the metropolis, the most considerable being the mint, a Grecian Doric edifice erected in 1811; the post office (1823–'9); the college of physicians; King's college, as the eastern wing of Somerset house (1831); and the British museum (1823–'47). These were all in the classical style. His chief Gothic works are the restorations of York minster and the improvements and extensions of the Inner Temple. He also erected buildings for the United Service, Carlton, and Oxford and Cambridge clubs, the last in conjunction with his brother Sydney. He was elected a royal academician in 1812, and in 1831 was knighted. He published "Specimens of Continental Architecture" (fol., London, 1806). **II. Sydney,** younger brother of the preceding, also an architect, died Dec. 11, 1877. His style was more ornate and florid than that of his brother, and was employed with effect upon several of the London club houses, especially the Carlton in Pall Mall. He also directed the restorations of the Temple church and Lichfield cathedral, and in 1847 succeeded his brother as architect of the British museum. He was elected a member of the royal academy in 1860, professor of architecture in 1861, and treasurer in 1862. He published "Suggestions on the Architectural Improvements of the West of London" (1834), and "Architecture of the Temple Church" (4to, 1842).

**SMITH,** the name of four counties in the United States. **I.** A central county of Mississippi, intersected by Strong river and drained by the head streams of Leaf river; area, 620 sq. m.; pop. in 1870, 7,126, of whom 1,711 were colored. The surface is generally level and the soil poor. The chief productions in 1870 were 144,688 bushels of Indian corn, 28,286 of sweet potatoes, 45,040 lbs. of rice, 5,666 of wool, and 2,411 bales of cotton. There were 1,065 horses, 2,027 milch cows, 4,308 other cattle, 3,694 sheep, and 11,254

swine. Capital, Raleigh. **II.** A N. E. county of Texas, bounded N. by the Sabine river and W. by the Neches, and drained by the sources of the Angelina; area, 900 sq. m.; pop. in 1870, 16,532, of whom 7,131 were colored. The greater portion of the surface is prairie land, and the soil is fertile. It is traversed by the International and Great Northern railroad. The chief productions in 1870 were 420,646 bushels of Indian corn, 22,017 of barley, 54,987 of sweet potatoes, 100,856 lbs. of butter, 1,878 gallons of molasses, and 9,322 bales of cotton. There were 1,988 horses, 1,189 mules and asses, 4,975 milch cows, 9,954 other cattle, 2,726 sheep, and 22,658 swine. Capital, Tyler. **III.** A N. county of Tennessee, intersected by the Cumberland river and drained by Caney fork; area, about 300 sq. m.; pop. in 1870, 15,994, of whom 3,536 were colored. The surface is rough, but the soil is generally fertile. The chief productions in 1870 were 126,837 bushels of wheat, 888,078 of Indian corn, 72,528 of oats, 17,996 of Irish and 15,163 of sweet potatoes, 2,250,202 lbs. of tobacco, 32,674 of wool, 255,723 of butter, 39,061 of honey, and 40,344 gallons of sorghum molasses. There were 4,857 horses, 3,715 milch cows, 6,117 other cattle, 17,591 sheep, and 33,687 swine. Capital, Carthage. **IV.** A N. county of Kansas, bordering on Nebraska, and intersected by the N. fork of Solomon river; area, 900 sq. m.; pop. in 1870, 66; in 1875, 3,876. The surface is undulating and fertile. Capital, Smith Centre.

**SMITH, Adam,** a Scottish philosopher, born at Kirkcaldy, Fifeshire, June 5, 1723, died in Edinburgh, July 8, 1790. He studied at the university of Glasgow for three years, and for seven years at Oxford. In 1748 he fixed his residence in Edinburgh, where under the patronage of Lord Kames he delivered lectures on rhetoric and belles-lettres. He was elected in 1751 professor of logic in the university of Glasgow, and was transferred in 1752 to the chair of moral philosophy in the same university, which he filled nearly 12 years. His course was divided into four parts. The first treated natural theology; in the second, devoted to ethics, he developed the doctrines contained in his "Theory of Moral Sentiments;" in the third, the subject of which was justice, he traced the gradual progress of jurisprudence and government; and in the fourth, the subject of which was expediency, he examined those political regulations which relate to commerce, finances, and ecclesiastical and military establishments, and which are calculated to increase the power and prosperity of a state. The last division included the substance of his work on the "Wealth of Nations." He published in 1759 his "Theory of Moral Sentiments," in which he maintains the doctrine that all moral emotions and distinctions spring from sympathy. (See Moral Philosophy.) From this time he devoted a larger portion of his lectures to jurisprudence and political economy. Near the close of 1763 he resigned his professorship to accompany the young duke of Buccleugh on his travels. They visited Paris, resided 18 months at Toulouse, passed two months at Geneva, and returning to Paris at the end of 1765, remained there nearly a year. He returned with his pupil to London in October, 1766, and soon after fixed his residence for ten years with his mother at Kirkcaldy, engaged in severe study, and occasionally visiting Edinburgh and London. For many years he enjoyed an intimate friendship with Hume. In 1776 appeared his "Inquiry into the Nature and Causes of the Wealth of Nations," which was the first complete and systematic statement of the principles of political economy. It received several additions in the third edition (1784), and was translated into the principal European languages. A new edition by J. E. T. Rogers was published in London and New York in 1870 (2 vols. 8vo). (See Political Economy, vol. xiii., p. 668.) Smith resided for two years after its publication chiefly in London, and in 1778 was appointed one of the commissioners of customs for Scotland, removing to Edinburgh. In 1787 he was elected lord rector of the university of Glasgow. A large proportion of his savings was allotted to secret charity.

**SMITH, Albert,** an English author, born at Chertsey, May 24, 1816, died at Fulham, near London, May 23, 1860. He was educated for the surgical profession in London and Paris, and joined his father in practice at Chertsey, but soon became a writer for the periodical press. Settling in London in 1841, he became a contributor to "Bentley's Miscellany," and within a few years produced "The Wassail Bowl," "The Adventures of Mr. Ledbury," "The Scattergood Family," "The Marchioness of Brinvilliers," "Christopher Tadpole," and "The Pottleton Legacy." He was also engaged for some time upon "Punch," his contributions to which included "The Physiology of Evening Parties," "The Medical Student," and other light varieties; and in 1847–'9 he produced a number of amusing trifles entitled "The Natural History of the Gent," "The Natural History of the Ballet Girl," "Stuck-up People," and "The Flirt." He also wrote Christmas adaptations from the tales of Dickens, burlesques, and other stage pieces, and was the dramatic critic of the "Illustrated London News." A journey to Constantinople in 1849 furnished him with materials for his "Month at Constantinople" (1850), and also for the public entertainment called the "Overland Mail," first brought out in May, 1850. In August, 1851, he made the ascent of Mont Blanc, and his "entertainment" founded thereon proved his most successful venture, being constantly repeated till 1858. He then visited China, and after his return gave a Chinese entertainment, which in the spring of 1860 was replaced by the more popular story of Mont Blanc. This he repeated until within two days of his death. His entertainments

were published under the titles "Story of Mont Blanc" (1853), and "To China and Back" (1859); and since his death his brother, Arthur Smith, has published from his sketches "Wild Oats and Dead Leaves" (1860), and "Paris and London" (1867).

**SMITH, Alexander,** a Scottish poet, born in Kilmarnock, Dec. 31, 1830, died at Wardie, near Edinburgh, Jan. 5, 1867. He was the son of a pattern designer, and himself became a pattern designèr for a lace factory in Glasgow. In 1852 he published serially in the "Critic" his poem "A Life Drama," issued with other poems in book form in 1853. In 1854 he was appointed secretary of the university of Edinburgh (a post which he retained till his death), and about the same time delivered a series of lectures. His later poetical works are: "Sonnets of the War," in conjunction with Sydney Dobell (1855); "City Poems" (1857); and "Edwin of Deira" (1861). He also wrote in prose "Dreamthorp" (1863); "A Summer in Skye" (2 vols., 1865); "Alfred Hagart's Household" (2 vols., 1866); and "Miss Oona McQuarrie" (1866). A posthumous volume, "Last Leaves," was edited by P. P. Alexander, with a memoir (1868).

**SMITH, Eli,** an American missionary, born at Northford, Conn., Sept. 15, 1801, died in Beyrout, Syria, Jan. 11, 1857. He graduated at Yale college in 1821, and at Andover theological seminary in 1826, and on May 23 of the latter year sailed as a missionary of the American board for Malta, where he took charge of the missionary printing establishment. In 1827 he went to Beyrout to study Arabic, and in 1828 returned to his work at Malta. In 1829 he made a tour with Dr. Anderson through Greece, and in 1830–'31 with Dr. Dwight of Constantinople through Armenia and Georgia to Persia, opening the way for the Nestorian mission at Urumiah. In 1832 he visited the United States, and published a work by himself and Dr. Dwight entitled "Missionary Researches in Armenia." He returned to Beyrout in 1833. In 1838 and again in 1852 he was the travelling companion and coadjutor of Dr. Edward Robinson in his explorations in Palestine. After the journey of 1838 he went to Leipsic to superintend the casting of a new font of Arabic type, in which he improved the form of the letters, making them more distinct and nearer the style of the written letters. He revisited the United States in 1839, and again, on account of illness, in 1845. From 1847 he was engaged upon a translation of the Bible into modern Arabic, which was completed by Dr. C. C. Van Dyke. He published a volume of sermons and addresses (1834).

**SMITH, Francis Hopkinson.** See p. 891.

**SMITH, George,** an English oriental scholar, born in 1840, died in Aleppo, Aug. 19, 1876. In 1866 he discovered among the Assyrian paper casts in the British museum an inscription of Shalmaneser II., giving an account of the war against Hazael. In 1867 he assisted in preparing a new volume of "Cuneiform Inscriptions of Western Asia" for the British museum. Thereafter the study of the cuneiform texts became his sole occupation. His principal earlier discoveries, published in the "Transactions of the Society of Biblical Archæology," are: a tablet noticing the eclipse of June 15, 763 B. C.; notices of the Israelitish kings Azariah, Pekah, and Hoshea; accounts of the conquest of Babylonia by the Elamites in 2280 B. C.; a curious religious calendar of the Assyrians; and a tablet containing the Chaldean account of the deluge, which he afterward discovered to be the eleventh in a series of twelve giving the history of an unknown hero, whom he believes to be the same as the Nimrod of the Bible. In 1871 he published, at the cost of Mr. Fox Talbot and Mr. J. W. Bosanquet, his great work on the history of Asshur-bani-pal, giving the cuneiform texts, transcriptions, and translations of the historical documents pertaining to this reign. In 1873 the proprietors of the "Daily Telegraph" sent him on an exploring expedition to Nineveh, and in 1874 he went there again. He obtained over 3,000 entire or fragmentary inscriptions, and many other objects of great importance. He published in 1875 an account of these explorations, and contributed a volume on the history of Assyria to the series of "Ancient History from the Monuments;" also "The Chaldean Account of Genesis" (German translation by H. Delitzsch, with notes by F. Delitzsch, 1876), a series of legends from the cuneiform inscriptions resembling the Biblical accounts. In March, 1876, he went again to the East.

**SMITH, Gerrit,** an American philanthropist, born in Utica, N. Y., March 6, 1797, died in New York, Dec. 28, 1874. He inherited from his father Peter Smith, a partner of John Jacob Astor in the fur trade, one of the largest estates in the country, consisting chiefly of land in almost every county of New York and in nearly all the states of the Union. He graduated at Hamilton college, Clinton, N. Y., in 1818, and for many years his chief occupation was the management of his property, his residence being at Peterboro, Madison co. He studied law, and was admitted to the bar when 56 years old (1853). In 1825 he joined the colonization society, and contributed largely for the removal of colored people to Africa. Ten years later he withdrew from it and joined the American anti-slavery society. He gave away large quantities of land in public and private charity, and in 1848 distributed 200,000 acres, in parcels averaging 50 acres. In 1852 Mr. Smith was elected a representative in congress; but he did not like public life, and resigned at the close of the first session. While in congress he voted with the party opposed to slavery, and made several speeches on that side. A few years later he contributed largely to the struggle for free institutions in Kansas, in which his friend John Brown became

prominent; and in 1859 he gave pecuniary aid to Brown in preparing for the attack on Harper's Ferry, though he probably had no precise knowledge of his plans. The failure of that attempt, and grief and anxiety for the loss of life which it occasioned, temporarily overthrew his reason, and for some months he was an inmate of the insane asylum at Utica. During the civil war he strongly advocated the cause of the Union and contributed largely for the raising of troops. After its close, he joined with Horace Greeley in 1867 in signing the bail bond by which Jefferson Davis was liberated. Mr. Smith was of a strongly religious nature, and he was in the habit of preaching in a church built by himself. His originally orthodox views underwent great changes, but he is said to have finally returned to them. He printed and distributed gratuitously many pamphlets, speeches, and addresses, and published in book form "Speeches in Congress" (1855); "Sermons and Speeches" (1861); "The Religion of Reason" (1864); "Speeches and Letters" (1865); "The Theologies" (2d ed., 1866); "Nature the Base of a Free Theology" (1867); and "Correspondence with Albert Barnes" (1868).

**SMITH, Goldwin,** an English author, born in Reading, Aug. 13, 1823. He was educated at Eton and Oxford, and was called to the bar at Lincoln's Inn, but never practised. In 1858 he became regius professor of modern history at Oxford. During the American civil war he was a warm friend of the federal government, and published "Does the Bible sanction Slavery?" (1863), "On the Morality of the Emancipation Proclamation" (1863), "Letter to a Whig Member of the Southern Independence Association" (1864), "England and America" (1865), and "The Civil War in America" (1866). In September, 1864, he visited the United States. In 1866 he resigned his chair at Oxford, with a view of taking up his residence in America. Coming to this country in 1868, he became professor of English history in Cornell university, and resided at Ithaca till 1871, when he exchanged his chair for that of a non-resident professor, and removed to Toronto. He has since been appointed a member of the senate of the university of Toronto, and from 1872 to 1874 was the editor of the "Canadian Monthly." In 1874 he revisited England. He contributed to the "Anthologia Oxoniana," the "Oxford Essays," and the "Encyclopædia Britannica." His other publications are: "Inaugural Lecture before the University of Oxford" (1859); "Lectures on Modern History," "Lectures on the Study of History," "Foundation of the American Colonies," "On some supposed Consequences of Historical Progress," and "Rational Religion" (1861); "Irish History and Irish Character," and "On Church Endowments" (1862); "Empire, a Series of Letters" (1863); "Plea for Abolition of Tests in Oxford" (1864); "Three English Statesmen," sketches of Pym, Cromwell, and Pitt (1867); "Reorganization of the University of Oxford" (1868); and "Relations between America and England" (1869).

**SMITH, Henry Boynton,** an American clergyman, born in Portland, Me., Nov. 21, 1815, died in New York, Feb. 7, 1876. He graduated at Bowdoin college in 1834, was some time a tutor there, and studied theology at Andover and Bangor, and subsequently at Halle and Berlin. He became pastor of the Congregational church in West Amesbury, Mass., in 1842, and professor of mental and moral philosophy in Amherst college in 1847. In 1850 he became professor of church history in the Union theological seminary, New York, and in 1855 of systematic theology, which chair he resigned in 1873. He was elected in 1863 moderator of the New School general assembly of the Presbyterian church, and at the opening of the next general assembly in Dayton, Ohio, in 1864, delivered a discourse which was published under the title "Christian Union and Ecclesiastical Reunion." He was subsequently a member of the general assembly's committee on reunion with the Old School general assembly, and presented a report on a doctrinal basis of union ("The Reunion of the Presbyterian Churches," 8vo, 1867). In 1867 he was a delegate to the evangelical alliance in Amsterdam, where he read a "Report on the State of Religion in the United States." He was a founder of the "American Theological Review," and its editor from 1859 to 1862, when it was consolidated with the "Presbyterian Review," which he edited till 1871. His principal works are: "The Relations of Faith and Philosophy" (8vo, 1849); "The Nature and Worth of the Science of Church History" (1851); "The Problem of the Philosophy of History" (1853); "The Idea of Christian Theology as a System" (1857); "An Argument for Christian Colleges" (1857); "History of the Church of Christ, in Chronological Tables" (fol., 1859); a new edition of the Edinburgh translation of Gieseler's "Church History" (5 vols. 8vo, 1859-'63), of which vols. iv. and v. were chiefly translated by Prof. Smith; a revised edition of the Edinburgh translation of Hagenbach's "History of Christian Doctrine" (2 vols. 8vo, 1861-'2); with James Strong, a new edition of the Edinburgh translation of Stier's "Words of the Lord Jesus" (in parts, 1864 *et seq.*); and with R. D. Hitchcock, "The Life, Character, and Writings of Edward Robinson" (1864).

**SMITH, James,** a signer of the Declaration of Independence, born in Ireland about 1719, died in York, Pa., July 11, 1806. He came to America with his father's family in 1729, studied law in Lancaster, Pa., and after his admission to practice removed to the neighborhood of Shippensburg, and engaged in surveying. After a few years he removed to York, which became his permanent home, and entered upon the legal profession. In 1774 he was chosen a deputy to attend the provincial

meeting, or rather "Committee for the Province of Pennsylvania," which convened at Philadelphia July 15. At this meeting he was one of those who were appointed to "prepare and bring in a draught of instructions to the representatives in assembly met." In 1776 he was chosen a member of the continental congress, in which he continued till 1778; and when congress held its sessions in York, the board of war occupied his law office.

**SMITH, James** and **Horace,** English authors, associated together in literary history. The former was born in London, Feb. 10, 1775, and died there, Dec. 24, 1839; and the latter was born in London, Dec. 31, 1779, and died at Tunbridge Wells, July 12, 1849. They were the sons of Robert Smith, a legal practitioner of London, and were early trained to an active business life, James in the professional business of his father, and Horace as a member of the stock exchange, in which business he acquired a fortune. The poetical imitations entitled "Horace in London," originally contributed to the "Monthly Mirror," and afterward republished in England and America, were written principally by James. In 1812 the rebuilding of Drury Lane theatre led to the offer of a prize for an opening address; the brothers, in six weeks, completed a series of parodies on the popular authors of the day, in the form of addresses for the prize, and thus arose the well known volume of "Rejected Addresses." The publisher Murray originally declined giving £20 for the copyright, but after it had run through 16 editions (1819) he purchased it for £131. James Smith during the remainder of his life wrote anonymously for amusement or relief from physical suffering, contributing *vers de société* and epigrams to the magazines or annuals, or assisting Charles Mathews the actor in the preparation of his "Country Cousins," his "Trip to France," and other "entertainments." A collection of his miscellaneous pieces in prose and verse was published after his death by his brother (2 vols., 1840). Horace, subsequent to 1820, when he retired from business, was for 25 years one of the most industrious authors of England. In 1826 appeared "Brambletye House," one of his earliest novels, and his most successful one. It was succeeded by "Tor Hill," "Reuben Apsley," "Jane Lomax," "The New Forest," and other novels, few of which are now known outside of the circulating libraries. In 1845 the author took a formal leave of the public in the preface to "Love and Mesmerism." A selection from the poetical works of Horace and James Smith, including the "Rejected Addresses," with a memoir by Epes Sargent, was published in New York in 1857. "The Tin Trumpet" (2 vols. 8vo), published anonymously in 1836, was republished in 1869 as the work of Horace Smith.

**SMITH,** Sir **James Edward,** an English botanist, born in Norwich, Dec. 2, 1759, died there, March 17, 1828. He studied medicine at Edinburgh, purchased the books, manuscripts, and herbarium of Linnæus, commenced the practice of his profession in London, received the degree of M.D. at Leyden, and in 1788 founded the Linnæan society of London, of which he was the first president. In 1796 he returned to Norwich, though he lectured on botany for two months each year at the royal institution. He wrote "English Botany" (36 vols., with 2,592 colored figures by Sowerby, London, 1792–1807); *Flora Britannica* (3 vols., 1800–'4); "Exotic Botany" (2 vols., 1804–'5); "Introduction to Systematical Botany" (1807); and "The English Flora" (3 vols., 1823–'5); and he edited Sibthorp's *Flora Græca* (1808).

**SMITH, John,** the founder of Virginia, born at Willoughby, Lincolnshire, England, in January, 1579, died in London, June 21, 1631. When young he took part in the wars in the Netherlands, and after four years' service returned home, but went abroad again to fight against the Turks. He distinguished himself by daring exploits in Hungary and Transylvania, and received from Sigismund Báthori a patent of nobility and a pension, but finally was taken prisoner, and sent as a slave to Constantinople. Here he gained the affection of his young mistress, who to secure his safety sent him to her brother, a pasha on the sea of Azov, with a letter in which she confessed her feelings. The proud prince, indignant at the attachment of his sister to a Christian, maltreated Smith, who at length, maddened by an insult, beat out his master's brains with a flail, put on the dead man's clothes, mounted his horse, and finally reached a Russian garrison on the Don. He was here kindly treated and helped on his journey to Transylvania, where he was furnished with money to repair his losses. Smith now returned to England, reaching it after a long journey and an attempt to take part in a war in Barbary, and was persuaded by Capt. Gosnold, who had already visited the coasts of America, to engage in the founding of a colony. The expedition, consisting of three vessels and 105 men, under the command of Newport, set sail Dec. 19, 1606. By the charter, the government of the colony was placed in the hands of a council app[illegible] and removable by the crown; their names [illegible] in a sealed box, not to be opened until their arrival at Virginia. On the voyage dissensions sprang up among the leaders, and much enmity was shown to Smith. At the Canaries he was charged with a conspiracy to make himself king of Virginia, and was kept prisoner for the rest of the voyage. After landing the box was opened, and although Smith was named one of the council, he was excluded. With Newport he headed a party of 20 men to discover the source of the James. About six weeks after, when Newport was returning to England, Smith's enemies urged him to return and be reprimanded by the council in England rather than suffer the disgrace of a public conviction in the colony; but he demanded a trial, which

resulted in his acquittal, and he was made a member of the council. Bad and scanty food brought on disease among the colonists and reduced their number. The president, Wingfield, embezzled the stores and was deposed. Ratcliffe was made his successor, but the real head was Smith, and to his efforts the salvation of the infant colony was owing. He set about the building of Jamestown, and after providing the settlers with lodgings made excursions into the neighboring country to obtain corn. On one of these expeditions he was taken prisoner by the Indians, and his life was saved, it is said, by the interference of Pocahontas. (See POCAHONTAS.) Sent back to Jamestown by Powhatan after an absence of seven weeks, he found the colony reduced to 40 men, and the most of these had determined to return to England. This, however, Smith prevented, and the arrival of Newport with 120 men raised the spirits of the colonists. In June and July, 1608, Smith explored the coasts of Chesapeake bay as far as the mouth of the Patapsco. On July 24 he started on another expedition, and explored the head of the Chesapeake, returning to Jamestown on Sept. 7. In these two voyages Capt. Smith sailed, by his own computation, about 3,000 m., and from his surveys constructed a map of the bay and the country bordering upon it. Being now president of the colony, he administered its affairs with energy; and his influence restored quiet to the colony, which had been filled with dissensions and disturbed by fears of the Indians. Smith's administration, however, had not been satisfactory to the company in England, whose too brilliant hopes had been disappointed, and whose irritation Smith's soldierly bluntness did not conciliate. A new charter was granted, and the powers previously reserved to the king were transferred to the company. Lord Delaware was made governor, and three commissioners, Newport, Sir Thomas Gates, and Sir George Somers, were empowered to manage the affairs of the colony till his arrival. They set sail with more than 500 emigrants, and a part of the fleet, in a shattered condition, and without the commissioners, reached Virginia in August, 1609. The new emigrants were mostly "dissolute gallants, packed off to escape worse destinies at home, broken tradesmen, gentlemen impoverished in spirit and in fortune, rakes and libertines, men more fitted to corrupt than found a commonwealth." Disorders quickly ensued, and Smith, at the request of the better part of the colony, resumed the government. The refractory were put in prison, and new settlements established. Returning from one of them, he was severely injured by the explosion of a bag of gunpowder, and in September, 1609, returned to England. In 1614 he explored with two ships the New England coast, and on his return presented to Prince Charles a map of the country between the Penobscot and Cape Cod. In 1615 he sailed again to New England, to found a colony. His vessel was captured by a French man-of-war, and he was carried to La Rochelle. He escaped, and on his return home wrote an account of his voyages to New England, which was published in 1616. The remainder of his life was passed in retirement. He published several works, the most important of which are "The Generall Historie of Virginia, New England, and the Summer Isles" (1626), and "The True Travels, Adventures, and Observations of Captain John Smith, in Europe, Asia, Affrica, and America, from 1593 to 1629" (1630). These two works were reprinted at Richmond in 1819. In 1631 he published also "Advertisements for the Unexperienced Planters of New England, or anywhere, or the Pathway to Experience to Erect a Plantation." This has been reprinted with a facsimile of Smith's map of New England (4to, Boston, 1865); also the "Description of New England" (4to, 1865), and "A True Relation of Virginia," reprinted from the London edition of 1608, with an introduction and notes by Charles Deane (4to, 1866).—See "Life of Capt. John Smith," by G. S. Hillard, in Sparks's "American Biography," vol. ii.

**SMITH, John Augustine,** an American physician, born in Westmoreland co., Va., Aug. 29, 1782, died in New York, Feb. 9, 1865. He went in 1809 to New York, where he edited the "Medical and Physiological Journal," and was a lecturer on anatomy in the college of physicians and surgeons. In 1814 he removed to Virginia, and was president of William and Mary college till 1826, when he resigned and returned to New York. He was president of the college of physicians and surgeons from 1831 to 1843, and editor of the "Medical and Physiological Journal." He published "Introductory Discourse at the New Medical College in Crosby Street" (1827); "Select Discourse on the Functions of the Nervous System" (1840); "The Mutations of the Earth" (1846); "Monograph upon the Moral Sense, two Discourses" (1847); "Prelections on Moral and Physical Science" (1853); and numerous essays and lectures on moral philosophy, physical science, &c.

**SMITH, John Lawrence,** an American chemist and mineralogist, born near Charleston, S. C., Dec. 16, 1818. He graduated at the university of Virginia and at the medical college of South Carolina, and for three years studied chemistry, physiology, physics, mineralogy, and geology in Europe. In 1844 he commenced the practice of medicine in Charleston, delivered lectures on toxicology, paid attention to agricultural chemistry, and ascertained the character and value of the marl beds extending 100 m. back of Charleston. In 1846 he was employed by the Turkish government to suggest improvements in the cotton culture in Asia Minor, and accepted the appointment of mining engineer. He remained four years, and in 1849 made a report on the "Thermal Waters of Asia Minor." His mining researches

in Asia Minor led to the subsequent discovery of emery and corundum in localities in the United States. After his return in 1851 he invented the inverted microscope, and was professor of chemistry in the university of Virginia, and subsequently in the medical department of the university of Louisville, Ky., and is now (1876) scientific superintendent of the Louisville gas works. In 1867 he was a commissioner to the Paris exposition, making a report on "The Progress and Condition of Several Departments of Industrial Chemistry," and in 1873 to the Vienna exhibition. In 1872 he was elected president of the American association for the advancement of science. His scientific reports are numerous, and his original researches, about 50 in number, have been collected in a volume, "Mineralogy and Chemistry: Original Researches" (8vo, Louisville, 1873). (See EMERALD, and EMERY.)

**SMITH, John Pye,** an English clergyman, born in Sheffield, May 25, 1774, died in Guildford, Surrey, Feb. 5, 1851. In his 22d year he entered the Independent academy at Rotherham, and in 1800 was chosen classical tutor in the Homerton theological academy. He subsequently became pastor of a church at Homerton, and in 1813 he was appointed divinity tutor. From 1843 to 1850 he was again classical tutor; but on the consolidation of Homerton, Highbury, and Coward academies into New college, he resigned. He was a fellow of the royal and of the geological society. His principal works are: "The Scripture Testimony to the Messiah" (3 vols., 1818–'21; 5th ed., 2 vols., 1868); "Four Discourses on the Sacrifice and Priesthood of Jesus Christ" (3d ed., 1827); "On the Personality and Divinity of the Holy Spirit" (1831); "The Mosaic Account of the Creation and the Deluge illustrated by the Discoveries of Modern Science" (1837); and "Scripture and Geology" (1839; 4th ed., greatly enlarged, 1848; 5th ed., 1854).—See "Memoirs of the Life and Writings of John Pye Smith," by J. Medway (1853).

**SMITH, Joseph,** founder of the Mormon church, or church of Latter Day Saints, born at Sharon, Vt., Dec. 23, 1805, killed at Carthage, Ill., June 27, 1844. His parents, of Scotch descent, early removed to Palmyra, N. Y. The family was disreputable, and Joseph's education was very defective. With the aid of Sidney Rigdon he brought forth the "Book of Mormon," which he pretended to have discovered under angelic guidance, written on plates and hidden in the earth; and on this he founded and organized his church in Manchester, N. Y., April 6, 1830. In 1831 he went with his disciples to Kirtland, O., and erected a costly but very singular temple. Here Smith and Rigdon engaged in fraudulent banking, were tarred and feathered for this and other offences in 1832, and after the failure of their bank in January, 1838, fled to Missouri. There, in a town named Far West, Smith's disciples gathered; but their irregularities occasioned an outbreak against them, and their speedy removal to Hancock county, Ill., where they built a city called Nauvoo, and constructed another costly temple. Here Smith, who combined in his own person the chief military, municipal, and ecclesiastical offices, introduced polygamy under a pretended revelation; but several outraged husbands revolted and established an opposition press, which Smith with a mob demolished. For this warrants were issued against Smith, his brother Hyrum, and others. The Smiths refused obedience to the authorities, the state militia were summoned, and war was threatened; but they were finally induced to surrender, and were imprisoned. Fearing their release, a mob gathered, overcame the prison guard, and shot the prisoners dead, Joseph defending himself with a revolver till his ammunition failed. (See MORMONS.)

**SMITH, Joseph Mather,** an American physician, born at New Rochelle, N. Y., March 14, 1789, died in New York, April 22, 1866. He graduated in medicine in 1815 at the college of physicians and surgeons, New York. In 1826 he was appointed professor of the theory and practice of medicine in the college of physicians and surgeons, and in 1829 attending physician to the New York hospital. In 1855 his chair was exchanged for that of materia medica and clinical medicine. His most important publications are: "Elements of the Etiology and Philosophy of Epidemics" (New York, 1824); "Report on Practical Medicine" ("Transactions of the American Medical Association," 1848, vol. i.); "Report on Public Hygiene" (ibid., 1850, vol. iii.); "Medical Topography and Epidemics of the State of New York" (ibid., 1860, vol. xiii.); and "Therapeutics of Albuminuria" ("Bulletin of the New York Academy of Medicine," 1863, vol. ii.).

**SMITH, Robert Payne,** an English orientalist, born in Gloucestershire in November, 1818. He graduated at Pembroke college, Oxford, in 1841, took orders, was curate of Trinity church and master of the academy in Edinburgh, and subsequently was head master of the proprietary school in Kensington. In 1857 he was appointed sub-librarian of the Bodleian library, with special charge of the oriental manuscripts. In 1865 he was made canon of Christ church, Oxford, and regius professor of divinity in the university. Since 1871 he has been dean of Canterbury. He has published annotated copies and English versions of Syriac manuscripts, including "Cyril of Alexandria's Commentary on St. Luke's Gospel" (4to, Oxford, 1858; English version, 2 vols. 8vo, 1859) and "Ecclesiastical History of John of Ephesus" (8vo, 1860). He has also published a Latin "Catalogue of the Syriac MSS. in the Bodleian Library" (4to, 1864), "Authenticity and Messianic Interpretation of the Prophecies of Isaiah" (8vo, 1862), and "Prophecy a Preparation for Christ" (Bampton lectures for 1869). In 1873 he prepared a paragraphic Bible for the society for promoting Christian

knowledge. In 1874 he was understood to be preparing a commentary on Jeremiah, for the "Speaker's Commentary," and was engaged upon the *Thesaurus Syriacus*, of which up to 1872 two parts had been published.

**SMITH, Samuel Stanhope**, an American clergyman, born at Pequea, Pa., March 16, 1750, died in Princeton, N. J., Aug. 21, 1819. He graduated at Princeton college in 1767, and from 1770 to 1773 was tutor there. He was then for some time a missionary in western Virginia, and was principal of the seminary which became the Hampden Sidney college. In 1779 he was appointed professor of moral philosophy in the college of New Jersey, of which he was president from 1794 to 1812. In 1786 he was associated with several other clergymen of the Presbyterian church in preparing the form of presbyterial government which continues to the present time. He published "Causes of the Variety in the Figure and Complexion of the Human Species" (8vo, 1787); "Sermons" (1799); "Lectures on the Evidences of the Christian Religion" (12mo, 1809); and "A Comprehensive View of the leading and most important Principles of Natural and Revealed Religion" (8vo, 1816). His "Sermons," with a memoir of his life and writings, were published in 1821 (2 vols. 8vo).

**SMITH. I. Seba**, an American author, born in Buckfield, Me., Sept. 14, 1792, died in Patchogue, L. I., July 29, 1868. He graduated at Bowdoin college in 1818, and settled in Portland, where he edited the "Eastern Argus" (1820–'24) and the "Courier" (1830–'37). In 1842 he removed to New York. He published "Life and Letters of Major Jack Downing" (Boston, 1833), a celebrated series of humorous political letters; "Powhatan," a metrical romance (1841); "Dewdrops of the Nineteenth Century," miscellanies (1846); "New Elements of Geometry" (1850); "Way Down East, or Portraitures of Yankee Life" (1854); and "My Thirty Years out of the Senate, by Major Jack Downing" (1859–'60). **II. Elizabeth Oakes** (Prince), an American authoress, wife of the preceding, born in North Yarmouth (now Cumberland), Me. She married Mr. Smith at the age of 16, and about the same time became an anonymous contributor of poems to the periodical press. After her removal with her husband to New York in 1842 she frequently appeared before the public as a lecturer. In 1843 appeared the first considerable collection of her poetical pieces under the title of "The Sinless Child and other Poems," and her metrical contributions to the magazines have since been numerous. She is the author of "The Roman Tribute" and "Jacob Leisler," tragedies; "The Western Captive" and "Bertha and Lily," novels; "The Salamander, a Legend for Christmas;" and children's books and miscellaneous publications. In 1851 she published "Woman and her Needs," a work devoted to the rights of woman, which Mrs. Smith has at various times advocated by her pen and as a lecturer. Among her later publications are: "Hints on Dress and Beauty" (1852); "Shadow Land" (1852); "The Newsboy" (1855); "Bald Eagle, or the last of the Ramapaughs" (1867); "Two Wives" (1871); and "Kitty Howard's Journal" (1871). She now (1876) resides at Hollywood, Carteret co., N. C.

**SMITH, Sydney**, an English author, born at Woodford, Essex, June 3, 1771, died in London, Feb. 22, 1845. He was educated at New college, Oxford, where in 1790 he obtained a fellowship of £100 a year. He took orders, and in 1794 became curate in the parish of Netheravon, in Salisbury plain; but three years later he went to Edinburgh as a private tutor. In 1802 he was associated with Murray, Jeffrey, Brougham, Horner, and others in establishing the "Edinburgh Review," to the first number of which, as editor, he contributed seven articles. Soon afterward he went to London, where his sermons attracted large and fashionable congregations, and in 1804–'6 he delivered courses of lectures on moral philosophy before the royal institution. A posthumous volume, entitled "Elementary Sketches of Moral Philosophy" (1850), contains the substance of these. Upon the return of the whigs to power in 1806, he was presented to the living of Foston-le-Clay in Yorkshire, worth about £500 a year. In 1807–'8 appeared anonymously his "Letters on the Subject of the Catholics, by Peter Plymley," which, owing to an admirable mixture of sound sense, irony, and pleasantry, had an immense circulation; and his efforts in the cause of Catholic emancipation were never relaxed until that measure was accomplished. In 1809 he published two volumes of sermons, and in the summer of that year removed with his family to Heslington, near York, where he resided for a few years, in the hope of being able to exchange Foston-le-Clay for some more desirable parish. Failing in this, he turned his thoughts toward Foston, the forlorn condition of which he characteristically described by saying it was "actually twelve miles from a lemon," constructed a parsonage, and in the spring of 1814 moved with his family into his new quarters. In 1828 Lord Lyndhurst appointed him canon of Bristol and rector of Combe-Florey, near Taunton, and three years later he received a prebendal stall in St. Paul's. The remainder of his life was devoted to the discharge of his official duties, and to literary labors; but he wrote nothing for the "Edinburgh Review" subsequent to 1827. Having come into the possession of a considerable estate by the death of his brother Courtenay in 1843, he invested largely in the public stock of Pennsylvania; and the neglect of that state to pay the interest on her bonds called out his "Petition to Congress" and "Letters on American Debts," writings overflowing with humorous invective. His humor never left him, and under the last regimen of his physician he expressed his longing for "even the wing

of a roasted butterfly." A collection of his writings, comprising his review articles, "Peter Plymley's Letters," and various pamphlets and miscellanies, was published in 1839–'40 (4 vols. 8vo; afterward in several other forms). He left also in manuscript an account of English misrule in Ireland, which his widow was advised by Macaulay not to publish. In 1855 appeared a memoir of him by his daughter Saba, the wife of Sir Henry Holland; and a volume of his writings and sayings, entitled "The Wit and Wisdom of Sydney Smith," was collected with a memoir by E. A. Duyckinck (New York, 1856).

**SMITH, Thomas Southwood,** an English physician, born at Martock, Somersetshire, Dec. 21, 1788, died in Florence, Italy, Dec. 10, 1861. He studied medicine at the university of Edinburgh, and settled in the country, but in 1820 removed to London, and was one of the founders of the "Westminster Review." His work on "The Use of the Dead to the Living," reprinted from the earlier numbers of the "Review," was instrumental in the passage by parliament of the anatomy act, which put an end to the business of "resurrection." In 1824 he was appointed physician to the London fever hospital, and somewhat earlier to the eastern dispensary. In 1832 he was one of the commissioners to inquire into the condition of factory children, and his report led to the passage of the factory act. In 1838 he presented to the poor-law commissioners the first of a series of reports on the "Physical Causes of Sickness and Mortality which are capable of Removal by Sanitary Regulations." This led to the appointment of a sanitary committee by the house of commons in 1840, and of the health of towns commission in 1842. Dr. Smith was appointed in 1840 a commissioner to inquire into the condition of children and young persons in the mines and factories not reached by the factory act, and his reports induced the exclusion of young children and women from mining labor. In 1847, as one of the metropolitan sanitary commissioners, he made a report on the means requisite for the improvement of the health of the metropolis, of which the result was the public health act of 1848 and the establishment of a general board of health. On its abolition he received a pension of £300. His principal works are: "Illustrations of the Divine Government" (Glasgow, 1814; 5th ed., London, 1866); "Treatise on Fever" (1830), long a standard with the profession; and "The Philosophy of Health" (2 vols. 12mo, 1835–'7; 12th ed., 1868).

**SMITH, William,** called the father of English geology, born at Churchill, Oxfordshire, March 23, 1769, died in Northampton, Aug. 28, 1839. In his youth he was a land surveyor and civil engineer, and was led to geological studies by his professional observations. He began in 1794 a "Map of the Strata of England and Wales," and in 1799 published in tabular form "The Order of the Strata and their Organic Remains in the vicinity of Bath, examined and proved prior to 1799." In 1801 a small geological map of England was produced, and in 1815 the "Geological Map of England and Wales, with Part of Scotland," with a treatise. Between 1819 and 1824 he published 21 geological maps of English counties, colored to represent the strata, and some works on organic remains. In 1824–'8 he lectured on geology. In 1831 he received from the geological society the Wollaston medal for his discoveries in geology.

**SMITH, William,** an English scholar, born in London in 1814. He was educated at University college, London, and studied law, but became professor of the Greek, Latin, and German languages at the Independent collegiate schools of Highbury and Homerton. In 1850 he was appointed professor of Greek and Latin in New college, London, and in 1853 classical examiner in the university of London. In 1867 he became editor of the "Quarterly Review." He has edited a "Dictionary of Greek and Roman Antiquities" (8vo, 1842); "Dictionary of Greek and Roman Biography and Mythology" (3 vols. 8vo, 1843–'9); "Dictionary of Greek and Roman Geography" (2 vols., 1854–'7); and "Dictionary of the Bible" (3 vols., 1860–'63). All these dictionaries have been abridged by him for the use of schools. The first and the abridged edition of the second and third combined have been edited by Charles Anthon (New York, 1843 and 1850). The "Dictionary of the Bible" has been abridged by the Rev. S. W. Barnum (New York, 1868), and edited and enlarged by Prof. H. B. Hackett (4 vols., New York, 1868–'70). He has also published a "History of Greece," and an abridgment of the same, an edition of Gibbon's "Decline and Fall of the Roman Empire," and a "Student's Gibbon," a "Student's Hume," and "Student's Hallam's Middle Ages," each in one volume; a Latin-English dictionary (1855), based on Forcellini and Freund; with J. D. Hall, "A copious and critical English-Latin Dictionary" (1870); with George Grove, a "Historical Atlas of Ancient Geography, Biblical and Classical" (1873); and "Modern Geography for Schools" (1873). In 1874 he was preparing "A Dictionary of Christian Antiquities" and "A Dictionary of Christian Biography and Doctrines." He has also published Latin and Greek courses for schools, and other educational works, of which numerous editions have been issued.

**SMITH, William Andrew,** an American clergyman, born in Fredericksburg, Va., Nov. 29, 1802, died in Richmond, March 1, 1870. In 1825 he was admitted to the Virginia conference of the Methodist Episcopal church. In 1833 he became agent of Randolph Macon college, after which he served as pastor of the principal Methodist churches of Richmond, Petersburg, Norfolk, and Lynchburg. He was a member of every general conference from

1832 to 1844, and also of the Louisville convention at which was organized the Methodist Episcopal church, South, and of every general conference of this body until his death. From 1846 to 1866 he was president of Randolph Macon college, and during this period not only filled the chair of moral science and presided over the college, but lectured extensively in Virginia and North Carolina. In the autumn of 1866 he was transferred to the St. Louis conference, and in 1869 was chosen president of Central university, Missouri. He was for a time editor of the Richmond "Christian Advocate," and published "Lectures on the Philosophy of Slavery" (Richmond, 1860), a defence of the institution as it existed in the southern states.

**SMITH,** Sir **William Sidney,** an English admiral, born at Midgham, Sussex, in 1764, died in Paris, May 26, 1840. He entered the navy at the age of 12, and before he was 20 was post captain, serving to the close of the American war. He subsequently participated in the war between Sweden and Russia as a captain in the Swedish service. Afterward, in command of a small English flotilla, he harassed French commerce in the channel, but in April, 1796, was captured by a superior force and confined in the prison of the Temple in Paris. The French government refused to exchange him, but he escaped by French aid after an imprisonment of two years. In 1798 he was put in command of a squadron to operate against the French on the coast of Egypt, and conducted the memorable defence of St. Jean d'Acre against Gen. Bonaparte. He signed a treaty with Gen. Kléber for the evacuation of Egypt by the French, which was disavowed by the British government; and he continued to participate in the war until compelled by wounds to return to England in 1801. He afterward returned to service, and at the close of the war received a pension of £1,000. In 1821 he was made an admiral. He was an early advocate of the abolition of the slave trade. Memoirs of his "Life and Times" were written by Sir John Barrow (2 vols., London, 1847).

**SMITHSON, James,** an English physicist, founder of the Smithsonian institution, born about 1765, died in Genoa, June 27, 1829. He was a natural son of Hugh, third duke of Northumberland, and Mrs. Elizabeth Macie, heiress of the Hungerfords of Audley, and niece of Charles, duke of Somerset. In 1786 he took the honorary degree of A. M. at Oxford, under the name of James Lewis Macie, but between 1791 and 1803 adopted the name of Smithson, the family name of his father. At the university he distinguished himself as a chemist, and was one of the first to adopt the method of minute analysis. He became the friend and associate of Wollaston, Banks, and Davy, and in 1787 was elected a fellow of the royal society and contributed eight papers to its "Transactions." His papers subsequent to 1818 were published in the "Annals of Philosophy" and other scientific periodicals. At his death he left about 200 manuscripts, probably intended to form portions of a philosophical dictionary. He bequeathed to his nephew £120,000, the whole of his property, which in case of the death of the latter without heirs was to go to the government of the United States to found at Washington, under the name of the Smithsonian institution, an establishment for the increase and diffusion of knowledge. (See Smithsonian Institution.)

**SMITHSONIAN INSTITUTION,** a scientific establishment in Washington, D. C., organized by act of congress in August, 1846, to carry into effect the provisions of the will of James Smithson. The condition on which the bequest was to take effect in favor of the United States having occurred in 1835, by the death of a nephew of the testator without issue, the Hon. Richard Rush was sent to London to prosecute the claim. On Sept. 1, 1838, he deposited in the United States mint the proceeds in English sovereigns, which amounted to $515,169. Suggestions were invited by the president as to the mode of disposing of the fund, which was in the mean time lent to Arkansas and other states to aid in internal improvements. The first section of the act of 1846, passed after several years' discussion of conflicting plans, creates an "establishment" for the increase and diffusion of knowledge among men, to consist of the president and vice president of the United States, the several members of the cabinet, the chief justice of the supreme court, the commissioner of the patent office, and the mayor of Washington, during their respective terms of office, with such other persons as these may elect honorary members of the institution. The second declares the original fund to be lent in perpetuity to the treasury of the United States at 6 per cent., payable semi-annually; appropriates the interest from Sept. 1, 1838, when the money was received, to July 1, 1846, amounting to $242,129, or so much thereof as might be necessary, for the erection of buildings and other current incidental expenses; and provides that all expenditures and appropriations shall in future be made exclusively from the accruing interest and not from the principal of the fund. By the third section a board of managers is constituted, under the name of "Regents of the Smithsonian Institution," to be composed of the vice president of the United States, the chief justice, the mayor of Washington, three members of the senate and three of the house of representatives, to be selected by the president and speaker thereof, with six other persons not members of congress, of whom two shall be resident in the city of Washington and the other four inhabitants of the United States, but no two of the same state. This board is required to elect one of its members as presiding officer, to be styled the chancellor of the institution, and also a suitable person to act as secretary both of the institu-

tion and the board. To this body is assigned the duty of a general superintendence, and of making an annual report to congress on the operations, expenditures, and condition of the institution. Sections 4, 5, and 6 assign a location and give power for "the erection of a suitable building of sufficient size, with apartments for the reception and arrangement upon a liberal scale of objects of natural history, including a geological and mineralogical cabinet; also a chemical laboratory, a library, a gallery of art, and the necessary lecture rooms;" and provision is made that all objects of art, natural history, &c., belonging to the United States, with such as may be collected from whatever source by the institution itself, shall be deposited in the building. Section 7 devolves on the secretary the charge of the building and property, and the duties of librarian and keeper of the museum, with the power of employing assistants, subject to the approval and removable at the discretion of the regents. Section 8 defines the visitorial relations of the members of the establishment toward the board of regents, and also limits the expenditure for the library. Section 9 authorizes the managers to dispose of such portion of the interest of the fund as the act has not otherwise appropriated, in such manner as they shall deem best suited for the promotion of the purpose of the testator. On this clause the present organization of the institution principally depends. In accordance with the requirements of this act of congress, a spacious building was erected, making provision for a library, museum, gallery of art, and lectures. The entire cost of the building, improvement of the grounds, &c., has been upward of $500,000. A library was begun, consisting chiefly of transactions and proceedings of learned societies obtained by exchange, and of other works by purchase necessary for general use, which has become unequalled in this country as a resource for scientific reference.

Smithsonian Institution.

The museum, enriched by the fruits of governmental expeditions and the contributions of individual explorers under the direction of the institution, has attained a magnitude and completeness seldom surpassed in collections for the illustration of natural science. A gallery of art was commenced, consisting principally of Indian portraits, engravings, and such articles as were presented to the institution by foreign governments; and lectures, chiefly on scientific subjects, were delivered up to 1865, when they were abandoned in consequence of a fire which destroyed the lecture room and afforded an opportunity of making important changes in the operations of the institution. The library was incorporated with that of congress, making the latter at once the largest in the United States, to which the institution annually contributes a copy of the transactions and proceedings of each of the principal societies of the world, and in return receives the use of all the books in the collection. Mr. W. W. Corcoran of Washington having founded a free public gallery of art, the institution has deposited in it its art collection. This is in accordance with the general plan of coöperating with the different establishments in the city of Washington, the institution having transferred to the department of agriculture its botanical collections, and to the army medical museum all specimens relating to medicine and anatomy, while it receives in return from these departments everything which relates to natural history and ethnology. The expense of the care of the grounds around the building, which at first devolved upon the institution, has been subsequently defrayed by government, and congress has been induced to make an annual appropriation for the support of the museum of $20,000. By these changes the burdens which congress placed upon the institution have been removed, and an opportunity is afforded for the expenditure of the income of the Smithson legacy, in strict conformity with the terms of the will, for the "increase and diffusion of knowledge among men."—In December, 1846, the board of regents selected Prof. Joseph Henry, then of the college of New Jersey at Princeton, as their secretary, which office he still holds (1876). His assistants are Prof. Spencer F. Baird, formerly of Dickinson college, Carlisle, Pa., in the natural history department (appointed in 1850), and William J. Rhees as chief clerk (appointed in 1853). The board of regents from its composition has necessarily changed to some extent almost every year, and of its original members none now remain. Soon after his appointment Prof. Henry submitted to the board a "programme

of organization" of the proposed operations under the 9th section, which was adopted, and still constitutes the basis of management. He suggested that men of talent and erudition should be afforded the means of conducting researches, and stimulated to exertion through facilities of publication and occasional compensation; and for its diffusion, the publication of such works as, while adding materially to the sum of human knowledge, would not find a remunerative sale in the ordinary channels of trade. He insisted that it ought to be a rule of the institution to do nothing which can be equally well done by any organization or instrumentality already in action. The results are as follows: 1. *Researches.* The claims of different classes of scientific research to the countenance and aid of the institution have always been pressing and difficult of adjudication; yet a preference has been given to those of widest influence and benefit to the race. Ethnology was believed to be one of these, and a valuable and expensive memoir on the archæology of the Indian tribes was the first to receive assistance. In connection with this, aid was extended to the compilation of a Dakota grammar and dictionary, and a grammar of the Yoruba language. The circulation of these has led to other researches in ethnology and kindred branches of science, some of which are receiving or will receive assistance. Astronomy has also engaged the earnest and continued efforts of the institution for its promotion theoretically and practically, and pecuniary assistance has been furnished to expeditions undertaken with a view to astronomical and other observations. It has not only furnished instruments for physical observation to expeditions, but in most cases has defrayed the expense of the reduction and publication of the results. In meteorology it had for many years 500 regular observers scattered over every part of the continent, and accumulated data through this and other measures steadily and systematically pursued for developing the laws which govern the phenomena of the weather. In accordance with the plan of coöperation adopted, this system has been transferred to the United States signal service. The natural history, geography, climatology, geology, mineralogy, botany, and archæology of this continent have through its aid received a greater impulse, and more material has been collected for increasing and diffusing the knowledge of them than through all other instrumentalities during the national existence. 2. *Publications.* These are of three classes. 1st. "The Smithsonian Contributions to Knowledge," comprised up to 1875 in 20 large quarto volumes, and in many cases expensively illustrated. No memoir is admitted into this series which rests on unverified hypothesis, or which does not offer some positive addition to the sum of existing knowledge; and the pretensions of each in this respect are decided by submission to the judgment of two or more arbiters of unquestionable competence and impartiality. The volumes thus far issued form a series for the publication of which no learned society in this country possessed the means, and which have only been equalled by foreign societies when aided by their governments. They have been distributed gratuitously among all the important libraries and learned associations of the world, and have afforded the means of obtaining by exchange those invaluable sets of the "Transactions" of foreign learned societies, not otherwise to be found in this country. 2d. The "Smithsonian Miscellaneous Collections," an occasional series comprising meteorological and physical tables, treatises on subjects of practical or scientific interest, and manuals for the collection and preservation of objects of natural history, as well as methods for various physical observations. This series includes 12 octavo volumes. 3d. The "Annual Reports" to congress, which, besides a popular analysis of the memoirs to be contained in the several forthcoming volumes of the "Contributions," are accompanied by a synopsis of lectures and original or translated articles, which introduce the student to information and topics of discussion much above the range of those usually presented even to the educated public. These are printed at the expense of congress, and are circulated through the members of both houses, as well as by the institution itself. 3. *Exchanges.* The institution now acts as the principal, and is gradually becoming the exclusive means of communication between the literary and scientific associations of the old and the new world. 4. *Scientific Correspondence.* The correspondence of the Smithsonian institution with all quarters of the globe is vast and constantly increasing. Almost every day brings narratives of real or supposed discoveries which are referred to the institution, inquiries on scientific topics of all kinds, or unusual phenomena, &c. These letters are all answered.—In 1865 a residuary legacy of Smithson was received, amounting to $26,210 63; and in 1874 a bequest of $1,000 from James Hamilton of Carlisle, Pa. With these, and savings of income and increased value of investments, the total permanent Smithson fund in the United States treasury, drawing interest at 6 per cent. in gold, now amounts to $651,000. There are besides depreciated investments valued in January, 1875, at $35,000, which with a cash balance on hand of $15,909 99 made the total resources at that time $701,909 99.

**SMOKE TREE.** See SUMACH.

**SMOLENSK. I.** A W. government of Russia, bordering on Tver, Moscow, Kaluga, Orel, Tchernigov, Mohilev, Vitebsk, and Pskov; area, 21,637 sq. m.; pop. in 1870, 1,140,015. The surface is an elevated undulating plain, broken occasionally by low hills. The chief rivers are the Dnieper and Desna. It is interspersed with numerous small lakes and morasses; and there

are immense forests of excellent timber, which abound with game. The soil is generally productive. Great numbers of cattle and of the celebrated Lithuanian horses are raised. Much attention is given to raising bees, and honey and wax form important articles of export. Iron, copper, and salt are found. Linen and woollen goods are manufactured, and fine carpets are exported. **II.** A city, capital of the government, on both sides of the Dnieper, 230 m. W. S. W. of Moscow; pop. in 1867, 22,977. It is considered the key to Moscow, and is strongly walled and fortified. It is the seat of a bishop, and has a remarkable cathedral and more than 20 other Greek churches. Its manufactures consist chiefly of linen and woollen cloths, leather, hats, and soap. It was important in the 9th century, and was long independent under its own princes. The Tartars, Lithuanians, and Russians afterward held it successively; and in the 16th and 17th centuries it was the scene of conflicts between the Poles and Russians, often changing masters, but finally taken by the latter in 1654. On Aug. 17, 1812, was fought the battle of Smolensk, between the French and the Russians. In the night the Russians abandoned the town, and on the morning of Aug. 18 it was occupied by the French, who next marched upon Moscow, leaving most of Smolensk in ashes. The town was subsequently rebuilt and greatly embellished.

**SMOLLETT, Tobias George,** a British author, born in Dalquhurn house, parish of Cardross, Dumbartonshire, in 1721, died at Monte Nero, near Leghorn, Oct. 21, 1771. He was educated at the grammar school of Dumbarton and at the university of Glasgow, and was apprenticed to a medical practitioner. When his apprenticeship expired, in his 19th year, he set out for London, carrying with him a tragedy entitled "The Regicide," which he vainly attempted to produce on the stage. Thwarted in his purpose, he accepted in 1741 the post of surgeon's mate on an 80-gun ship, and sailed on the disastrous expedition against Cartagena, which he has described in "Roderick Random," and with more detail in the "Compendium of Voyages." He left the navy at Jamaica, and while there became acquainted with Anne Lascelles, whom he married in 1747. Returning to England in 1746, after the battle of Culloden, he produced anonymously "The Tears of Scotland," an ode lamenting the atrocities of the royal army. He also published "Advice, a Satire" (1746), and "Reproof, a Satire" (1747), and wrote "Alceste, an Opera," for the Covent Garden theatre, which was withdrawn in consequence of a quarrel with the manager. In 1748 appeared the first of his novels, "The Adventures of Roderick Random." He made a short visit to Paris in 1750, and in 1751 published "The Adventures of Peregrine Pickle," which is disfigured by an episode detailing the intrigues of Lady Vane, for inserting which he is said to have received a liberal reward from her. He now resumed the medical profession, settled at Bath, and published in 1752 "An Essay on the External Use of Water." Obtaining no practice, he removed to Chelsea, and devoted himself again to literary pursuits. In 1753 appeared his "Adventures of Ferdinand Count Fathom." In 1755 he published by subscription his translation of "Don Quixote," more animated and elegant but less accurate than that of Jarvis, on which it was founded. Afterward he undertook the management of the "Critical Review." His irritable temper and capricious tastes involved him in numerous vexations and quarrels; a contemptuous critique on the "Rosciad" provoked against him the spleen of Churchill; and in 1759 an attack on Admiral Knowles, one of the commanders at Cartagena, caused him. to be arraigned for libel and sentenced to a fine of £100 and three months' imprisonment. He had meantime produced a "Compendium of Authentic and Entertaining Voyages" (7 vols., 1757), a comedy entitled "The Reprisals," which Garrick brought out on the stage, and a "Complete History of England" (4 vols., 1757–'8), written in 14 months, which became very popular. While in prison he wrote "The Adventures of Sir Launcelot Greaves," a sort of travesty of "Don Quixote," which appeared in the "British Magazine" in 1760–'61. He afterward contributed the accounts of France, Italy, and Germany to the "Modern Universal History," and continued his "Complete History of England," bringing the narrative down from 1748 to 1764. The whole work was in 16 vols. 8vo, of which only the last 5 vols., forming a continuation to Hume, are now read. On the accession of George III. he undertook to defend the administration of Lord Bute in a weekly paper entitled "The Briton." He was effectively and abusively answered by Wilkes in his "North Briton," and his services being unpaid, and his side most unpopular, he withdrew from the contest. His health was shattered by this discomfiture, by his labors on a translation of the works of Voltaire and on a compilation entitled "The Present State of All Nations," and by the death of his only child; and in 1763 he went abroad for two years. In 1766 he published "Travels through France and Italy," which was ridiculed by Sterne in his "Sentimental Journey." On returning from Italy he visited Scotland, resided at Bath during the following year, and there wrote "The Adventures of an Atom," a political satire, in which he assailed Lord Bute and the earl of Chatham. His broken health obliged him again to seek a milder climate, and he went to Italy in 1770, beginning on his way to write "The Expedition of Humphrey Clinker," which appeared in 1771, just before his death.—His life has been written by Thomas Roscoe, Dr. Moore, and others. One of the best editions of his works appeared in 1873 (8 vols. 8vo, London).

**SMYRNA** (Turk. *Ismir*), a town of Asiatic Turkey, capital of the vilayet of Aidin, near the head of the gulf of Smyrna, on the W. coast of Asia Minor, 210 m. S. W. of Constantinople; pop. (according to the Austrian consul general Scherzer's estimate in 1873) about 155,000, including 75,000 Greeks, 45,000 Turks, 15,000 Jews, 10,000 Roman Catholics, 6,000 Armenians, and 4,000 Europeans and Americans. Another estimate places the population at 180,000. Owing to the large preponderance of the Christians, it is called by the Turks the Giaour city. It stands upon a plain between the ancient Mt. Pagus and the sea, part of it on the slope of the hill. The streets are generally narrow and dirty. An interesting locality is the so-called caravan bridge, with adjoining grounds for the accommodation of camels during the night. Along the shore and in its vicinity reside the Christians, excepting the Armenians, whose quarter is partly on the lower slopes of the hill, the upper slopes being occupied by the Turks; and in the region between the Armenians and Turks live the Jews, who are chiefly of Spanish descent and mostly poor. On the summit of the hill is a castle. A quay is in course of construction. Smyrna contains a governor's palace, churches for various denominations, a convent, and several schools, that of the Prussian deaconesses being the best. A large Roman Catholic cathedral is in course of construction. An archæological school was projected in 1874 for promoting excavations at the site of ancient Ephesus, adjoining a station on the Smyrna and Aidin railway. Another line to Ala-Shehr (the ancient Philadelphia) was extended from Kassaba in 1875. A Turkish governor general, and Greek, Armenian, and Roman Catholic archbishops reside in the city; and there are

Smyrna.

American and other missionaries. In the adjoining villages of Burnabad and Budja are fine villas. Smyrna is an important station for steamers and a great commercial emporium; the harbor is magnificent, and at all times crowded with shipping. The entrances in 1873 were 630 steamers and 785 sailing vessels, tonnage 659,247; clearances, 627 and 693, tonnage 648,579. The imports, chiefly cotton and other manufactured goods, amounted to $23,332,780, and the exports, including cotton, figs, raisins, opium, sponges, and valonia, to $20,794,332. The shipments of cotton, now so important, were insignificant previous te the American civil war. In 1873-'4 the imports from the United States, chiefly petroleum, were valued at $300,000, and the exports to the United States, including opium, figs, liquorice root, wool, and rags, at $2,234,344.—Smyrna was probably colonized by Æolians from Cyme, but early fell into the hands of the Colophonians, and in the 7th century B. C. formed the 13th city of the Ionian league. According to Strabo, it was destroyed by Sadyattes of Lydia about 627, and remained in ruins for several centuries. It was rebuilt and enlarged by Antigonus and Lysimachus, successors of Alexander the Great, and became one of the first cities of that era. One of the seven churches mentioned in the book of Revelation was at Smyrna, and Polycarp was its first bishop. The town was destroyed by an earthquake in A. D. 178, and rebuilt by Marcus Aurelius. It afterward had many changes of fortune; and being occupied by a Seljuk chieftain about the end of the 11th century, it was nearly destroyed by the Byzantine fleet. It was again rebuilt, and subsequently the Genoese held it for a long period. In the latter part of the 14th century it was taken by the Turks, in whose

possession it ultimately remained, after being captured in 1402 by Tamerlane. Among its many calamities in modern times were the conflagration of 1841 and the earthquake of 1846. In July, 1853, Martin Koszta was delivered here from the hands of the Austrians by Capt. Ingraham.—See Scherzer's *La province de Smyrne* (1875).

**SMYTH**, a S. W. county of Virginia, bounded S. E. by the Iron mountain range and drained by the head streams of Holston river; area, about 500 sq. m.; pop. in 1870, 8,898, of whom 1,244 were colored. The surface is an elevated valley between the Iron mountain range and Walker's mountain; the soil is very fertile. Limestone, gypsum, and salt are found. It is traversed by the Atlantic, Mississippi, and Ohio railroad. The chief productions in 1870 were 44,681 bushels of wheat, 96,829 of Indian corn, 66,323 of oats, 3,327 tons of hay, 1,575 lbs. of tobacco, 10,514 of wool, 64,910 of butter, 26,820 of cheese, 3,113 of flax, and 9,897 of honey. There were 1,595 horses, 1,846 milch cows, 3,193 other cattle, 4,553 sheep, and 4,059 swine. Capital, Marion.

**SMYTH, Thomas**, an American clergyman, born in Belfast, Ireland, June 14, 1808, died in Charleston, S. C., Aug. 20, 1873. He was educated in Belfast and London, and in 1830 entered the theological seminary at Princeton, N. J. From 1832 till his death he was pastor of the second Presbyterian church in Charleston, S. C. Among the numerous works of Dr. Smyth are: "Lectures on the Prelatical Doctrine of Apostolic Succession" (Boston, 1841); "The Ecclesiastical Catechism" (1841); "Ecclesiastical Republicanism" (1843); "Presbytery and not Prelacy the Scriptural and Primitive Polity" (1843); "Calvin Defended" (Philadelphia, 1844); "The Rite of Confirmation" (1845); "The Name, Nature, and Functions of Ruling Elders" (1845); "The History, Character, and Results of the Westminster Assembly of Divines" (New York, 1847); "The Unity of the Human Races proved to be the Doctrine of Scripture, Reason, and Science" (1850); "Nature and Claims of Young Men's Christian Associations" (Philadelphia, 1857); "Faith the Principle of Missions" (1857); "The Well in the Valley" (1857); and "Obedience the Life of Missions" (1860).

**SMYTH. I. William Henry**, a British naval officer, born in Westminster, Jan. 21, 1788, died near Aylesbury, Sept. 9, 1865. He entered the navy in 1805, and rendered important aid in the defence of Cadiz in 1810. He became lieutenant in 1813, and soon afterward was appointed to a command in the flotilla under Sir Robert Hall detailed for the defence of Sicily. By order of the lords of the admiralty he made an elaborate survey of Sicily and the adjacent islands, which occupied him for several years, and resulted in the publication by the admiralty of an atlas of Sicily. As an accompaniment to this, he published a "Memoir descriptive of the Resources, Inhabitants, and Hydrography of Sicily and its Islands, interspersed with Antiquarian and other Notices" (4to, 1824). He afterward completed the survey of the shores of the Adriatic, and was employed in 1823 and 1824 in a survey of the coasts of Sardinia, and published a "Sketch of the present State of the Island of Sardinia" (8vo, 1828). He attained the rank of post captain in February, 1824, and settled soon after at Bedford, where he built a small observatory, and in 1844 published a "Cycle of Celestial Objects, for the use of Naval, Military, and Private Astronomers" (2 vols. 8vo). In 1853 he attained the rank of rear admiral, and in 1857 he was appointed hydrographer to the admiralty. His most valuable work is entitled "The Mediterranean, a Memoir, Physical, Historical, and Nautical" (8vo, 1854), in which he gives in systematic and condensed form the results of his numerous surveys and observations on the physical geography of that sea. He also wrote "Sidereal Chromatics" (1864), and "The Sailor's Word Book" (1867). **II. Charles Piazzi**, son of the preceding, has held the post of astronomer royal for Scotland. In 1856 he transported a large collection of meteorological, magnetical, and astronomical instruments to the peak of Teneriffe, where he selected two stations, one 8,840, and the other 10,700 ft. above the sea, and obtained important results detailed in his "Teneriffe, an Astronomer's Experiment" (London, 1858). He has since written "Three Cities in Russia" (1862); "Our Inheritance in the Great Pyramid" (1864; new ed., 1874); "Life and Work at the Great Pyramid" (1867); "On the Antiquity of Intellectual Man, from a Practical and Astronomical Point of View" (1868); and "Equal Surface Projection for Maps of the World" (1871). He maintains that the pyramids are memorials of a system of weights and measures intended to be perpetual.

**SNAIL**, the common name of the *helicidæ*, a large family of gasteropod mollusks, terrestrial and air-breathing. The number known is now so large that the treatment of the subfamilies and genera would require a volume. Restricting the name *helicidæ* to such as have a well developed external spiral shell, the snails may be characterized as animals breathing air by means of branchial vessels spread like a network over the internal walls of a cavity in the anterior part of the body, covered by the shell, and communicating with the atmosphere by a small valvular opening on the right side; they have four retractile tentacles, the upper two the largest and having eyes at the apex; there is a dentated horny jaw on the upper lip, which is opposed by the tongue; the gullet is wide, with large white salivary glands on its sides, and the liver is well developed; the whole body is very glutinous; the locomotion is slow, by means of the ventral foot; they are hermaphrodite, with reciprocal impregnation. The shells are always external, vary much in form, and contain the entire animal;

they have no operculum, the opening during hibernation being closed by a secretion from the mantle, which hardens into what is called the epiphragm; the shell is generally turned from left to right, the free edge to the right, but they are often reversed; the newly hatched young resemble their parents, and have a shell of one whorl and a half. They are sensitive to cold, and like moist places; the sense of touch is acute, especially in the tentacles, and they appear to have a sense of smell; they are nocturnal, and feed principally on plants, though sometimes devouring each other. The reproductive season is toward the end of spring; the eggs, to the number of 30 to 100, are deposited in moist places, in natural or artificial holes; the young come out in 20 to 30 days. Snails are distributed very widely, from the northern limit of trees to Tierra del Fuego, from the hot and moist plains to a height of 11,000 ft. on mountains; some are cosmopolite, ranging wherever their food is found, and others are restricted within narrow limits. About 1,500 species have been described, some of which from their voracity are very injurious to vegetation, and some useful to man as food; they are very tenacious of life, and able to resist long droughts. A specimen of the desert snail of Egypt (*helix desertorum*), which remained dormant in the British museum four years, afterward lived in the possession of one of the curators more than two years.—The genus *helix* (Lam.) is the type of the family. The Roman or vineyard snail (*H. pomatia*, Linn.) is a large species, reddish brown with paler bands; these snails were used as food by the ancient Romans, who reared them in parks, and fattened them on cooked meat and flour, obtaining them from the islands of the Mediterranean; they are still eaten in many countries of Europe, especially by Roman Catholics during Lent, being considered as fish; great numbers are eaten in France; they are also recommended as an ingredient in soups for consumptive persons. The reproductive internal organs, in the apex of the shell, consist of many parallel cæca, each of which has an external layer producing eggs, and an internal sac producing semen; the apparatus is very complex. The *H. aspersa* (Linn.), or common garden snail, originally from Europe, but now naturalized in most parts of the globe, is also used as food, when boiled in milk, for consumptives. These species when abundant are very destructive, laying waste whole gardens in a single night, always attacking the tenderest and most succulent plants; besides their natural enemies, mammals and birds, great numbers are killed by fires, inundations, sudden changes of temperature, felling of forests, cultivation of the land, and by hogs and poultry following the plough; the remedies for their depredations are the same as for the slugs. The largest of the American snails is the *H. albolabris* (Say), of a yellowish horn color, with white, broadly reflected lip; the shell has five or six whorls, with minute revolving lines and the umbilicus closed; in October they cease feeding, and select a place under some log or stone, where they fix themselves for the winter,

American Snail (Helix albolabris).

mouth upward. For details on the American species, see Dr. A. Binney's "Terrestrial Air-breathing Mollusks of the United States" (3 vols., Boston, 1851, and vol. iv., a continuation by G. W. Binney, Boston, 1859).

**SNAKE.** See SERPENT.

**SNAKE BIRD.** See DARTER.

**SNAKE RIVER** (also called Lewis fork or river, Saptin river, and Shoshone river), a tributary of the Columbia, rising in the Rocky mountains in N. W. Wyoming, near the sources of the Yellowstone and Madison rivers, at an elevation of about 8,000 ft. above the sea, about lat. 44° N., lon. 110° 30′ W. It flows N. W. to the junction of Lewis fork, the outlet of Shoshone and Lewis lakes; then S., expanding in its course into Jackson lake, and again N. W. to the junction of Henry's fork (a total course of nearly 200 m.) in Idaho, about lat. 43° 15′, lon. 112°. Henry's fork rises in Henry lake (6,443 ft. above the sea, about lat. 44° 30′, lon. 111° 30′) in E. Idaho, on the border of Montana, near the head waters of Jefferson river, and has a S. course. From the junction the Snake describes a curve of more than 350 m. through S. Idaho, flowing S. W. and then N. W., and strikes the Oregon border in about lat. 44° 40′; it then flows N. about 200 m., separating Idaho from Oregon and Washington territory, when in about lat. 46° 30′ it turns W. into Washington, and after a further course of about 150 m. falls into the Columbia about 20 m. above the Oregon boundary, about lat. 46° 15′, lon. 119°. Its total length is upward of 900 m. Steamers ascend to Lewiston on the Idaho border; navigation is then impeded for more than 100 m. by shallows and rapids, above which the river is again navigable for 150 or 200 m. In its course through S. Idaho, the Snake flows through a vast cañon, varying in depth from 100 to 1,000 ft.; many of its tributaries sink, and, passing under the strata of lava, fall from the sides of the cañon into the main stream; and here occur the American, Shoshone, and Salmon falls, for an account of which see IDAHO, vol. ix., p. 167. Its chief tributaries on the right bank are the Malade from the north; the Boisé, Payette, Weiser, Salmon, and Clearwater (which enters at the point where the Snake leaves the Idaho boundary) from the east; and the Palouse (in

Washington) from the north. On the left bank it receives among others the Blackfoot, Port Neuf, Bannack, Raft, Goose, Salmon, and Bruneau, in Idaho; the Owyhee, Malheur, Burnt, and Powder, in Oregon; and the Grande Ronde, just within Washington territory.

**SNAKEROOT,** a common name, usually with a prefix, for several plants which are botanically very distinct, applied to them because they were supposed, especially by the Indians, to be efficacious against the poisonous bites of serpents. 1. Seneca snakeroot (officinal as senega) is *polygala senega.* The genus *polygala* (Greek *πολύς*, much, and *γάλα*, milk, as some species were formerly supposed to increase the secretion of milk) has about 200 species, widely distributed, about 25 of which belong to this country, and a few showy exotics are grown as greenhouse plants. The flowers have the general appearance of those of the *leguminosæ*, but their structure is quite different and is difficult to describe; two of the five sepals are colored and petal-like, while the three proper petals are united, the middle one keeled-shaped and often bearing a crest; the six or eight stamens are united by their filaments in two sets, the anthers one-celled and opening by a hole at the top; pod small and two-seeded. *Polygala polygama* and *P. pauciflora*, both pretty native species, produce, besides ordinary flowers, numerous fertile flowers on short underground runners. *P. senega*, the thick, hard, and knotted rootstocks of which are the seneca snakeroot of the shops, is found from New England southward and westward; the stems are about a foot high; leaves lanceolate, and the white flowers in close terminal spikes. The dried root has a peculiar odor and an acrid taste when chewed; it contains a principle called senegine, probably the same that has been called polygalic acid, and closely allied to saponine. The drug was first introduced into Europe as the Seneca rattlesnake root about 1734, and in 1749 Linnæus wrote a dissertation upon the drug. It is a stimulant expectorant, and in large doses emetic and diaphoretic; it is chiefly used in the compound sirup of squills, or hive sirup.

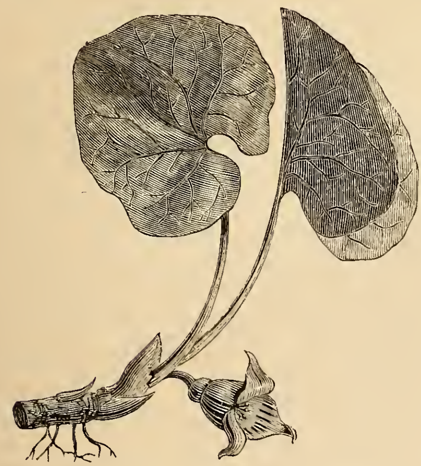
Seneca Snakeroot (Polygala Senega). Part of Root of natural size.

2. Virginia snakeroot, as found in the shops, is the root of *aristolochia serpentaria* and its varieties. The genus *aristolochia* is apetalous, and comprises low herbs and climbing vines; the tubular calyx is often curiously bent and inflated, and in some of the hothouse exotic species presents some of the strangest forms to be found among flowers.

Virginia Snakeroot (Aristolochia serpentaria).

The best known species is *A. sipho*, which, under the name of Dutchman's pipe (from the shape of the flowers), is often cultivated as a vine for verandas. The medicinal species has a weak stem about a foot high, usually heart-shaped leaves, and a few inconspicuous flowers close to the root, the calyx tube being curved like the letter S. It is most abundant in the middle states and southward, but like most medicinal plants has become rare in the older states. The dried root, when bruised, has a marked odor and taste, which have been compared to camphor, valerian, and turpentine combined; it contains an essential oil and a resin. Virginia snakeroot had a high reputation with the Indians as a cure for snake bites, and was early introduced into England as a remedy for the bite of reptiles and rabid dogs, and was officinal in the London Pharmacopœia of 1650. It is now used only as a stimulant tonic and diaphoretic, and has been employed in the treatment of intermittent fevers. 3. Canada snakeroot, also called wild and Indian ginger, is *asarum Canadense.* The genus *asarum*, with the preceding one, belongs to the family of *aristolochiaceæ*, and consists of low stemless herbs, from the creeping rootstocks of which rise usually one or two heart-shaped leaves on long petioles, and a short-peduncled flower, which appears in early spring; the regular calyx has three equal lobes, brownish purple, enclosing 12 stamens and the large pistils. *A. Canadense* has broadly heart-kidney-shaped deciduous leaves, in pairs, with the flower between them. The dried rootstock is in contorted pieces about the size of a quill, with an odor and a taste somewhat between

those of ginger and cardamoms; it contains an essential oil; it is an aromatic stimulant, and is sometimes used to modify the action of other medicines; in domestic practice a tincture is used in colic, and in some parts of the country it is made to serve the purpose of ginger in cookery; it is one of the things chewed to conceal a bad breath. Two evergreen species are found from Virginia southward: *A. Virginicum*, with small round-heart-shaped, and *A. arifolium*, with large halberd-shaped leaves; both possess similar aromatic rootstocks, and the leaves of all three, when dried, powdered, and used as snuff, are said to have similar properties with the foreign *A. Europæum*, or asurabacca, in producing sneezing and a copious flow of mucus from the nose.—Black snakeroot is *sanicula Canadensis* and *S. Marilandica.* Button snakeroot is *eryngium yuccæfolium;* the same name is also given to some



Canada Snakeroot (Asarum Canadense).

species of *liatris.* White snakeroot is *eupatorium ageratoides.* Snakehead is *chelone glabra.*

**SNAKES,** a family of American Indians. See Shoshones.

**SNAPPING TURTLE** (*chelydra serpentina*, Schweig.; genus *chelonura*, Fleming), an American species of fresh-water chelonians, characterized by a large head, with both jaws strongly hooked and two barbels under the chin, short and pointed snout, the nostrils near together, and the eyes large, prominent, and far forward; the sternum is small, cruciform, immovable, and covered with twelve plates and three supplemental ones; the carapace oblong, depressed, more or less tricarinated, deeply notched behind with three points on each side of the central notch; the neck long and thick, with a warty skin; tail very long, surmounted by a scaly or tuberculated crest; the anterior limbs with five nails, the posterior with four; the skin of the limbs above and below scaly. The head may be in great part retracted within the shell, whence it can be very suddenly extended by the long and extensile neck, but the limbs and feet are mostly exposed. The shell is dusky above,

Snapping Turtle (Chelydra serpentina).

and the lower parts yellowish; it attains a length of more than 4 ft. and a weight of 50 lbs.; it prefers sluggish and deep water in ponds or rivers, keeping principally at the bottom; it is very voracious, and feeds on fish, reptiles, and such aquatic birds as come within its reach, especially young ducks and goslings and wounded birds; it has been known to attack man, and is not unfrequently caught with hooks; its flesh is much esteemed for soups, though in the old animals it has a musky odor. It goes far from water to deposit its eggs; though an excellent swimmer, it is awkward on land, walking slowly, with the head, neck, and tail extended, raised on the legs like an alligator, whence it is called by the negroes alligator cooter; it is very savage if attacked, raising itself with such quickness on its legs as to elevate the whole body from the ground and enable it to make considerable hops, snapping with great ferocity and quickness at any object coming within reach of its long neck; its bite is severe and tenacious. It is distributed from Maine to Georgia, and westward to the Mississippi, being replaced further west by the *C. Temminckii* (Troost; genus *gypochelys*, Ag.), characterized by a larger triangular head, rougher shell, and neck and limbs covered with spiny warts. In the northern states it lays its eggs, 20 to 40, between June 10 and 25, generally in the forenoon, and in captivity a month later; it excavates a hole at first directly down and then laterally, so that the widest part, where the nest is, is on one side; sometimes several holes are dug, before one is found to suit; the females lose their shyness at this time, and smooth the earth over with care after the eggs are deposited.—In some parts of the country, the soft-shelled turtles (*trionycidæ*) are called snapping turtles. The eggs in these species are nearly globular, about an inch in diameter, white, and with hard shells.

**SNEEZING,** a modification of the ordinary respiratory movements, accompanied by a violent expiratory effort, sending forth a blast of air from the lungs intended to expel some irritating substance from the nasal air passages. It differs from coughing in the communication between the larynx and mouth being partly or wholly cut off by the drawing together of the

sides of the soft palate over the back of the tongue, so that the blast of air, by a convulsive movement, passes through the nose with more or less noise instead of through the mouth. It may be excited by acrid vapors, irritating liquids or solids, diseased secretions, or the simple entrance of air when the Schneiderian membrane is peculiarly irritable.

**SNELL, Willebrord,** a Dutch mathematician, born in Leyden in 1591, died there, Oct. 31, 1626. He studied law, but devoted himself principally to mathematics. When 17 years old he published an essay in which he endeavored to restore a lost treatise of Apollonius. He travelled in Germany, and won the friendship and esteem of Kepler. In 1613 he succeeded his father as professor in the university of Leyden. He was the first to make a trigonometrical measurement of an arc of a meridian, and thence to calculate the size of the earth. His result was erroneous, on account of the imperfection of the instruments then in use; but he himself discovered the errors. He also discovered the law of the refraction of light (see LIGHT, vol. x., p. 438), and improved the methods of approximating to the ratio of the radius to the circumference of the circle. His most important work is *Eratosthenes Batavus, sive de Terræ Ambitus vera Quantitate* (Leyden, 1617).

**SNELLING, Josiah,** an American soldier, born in Boston in 1782, died in Washington, D. C., Aug. 20, 1828. He was appointed a lieutenant in the 4th infantry in 1808, became captain in 1809, distinguished himself in the battle of Tippecanoe in 1811, and was made brevet major for services at the battle of Brownstown, Aug. 9, 1812. In 1814 he was made inspector general with the rank of colonel, and was prominent in the affair of Lyon's creek. In 1819 he was made colonel of the 5th infantry. He was a witness against Hull at his trial, and wrote "Remarks on General William Hull's Memoirs of the Campaign of the Northwestern Army, 1812" (8vo, Detroit, 1825).

**SNETHEN, Nicholas,** an American clergyman, born at Fresh Pond (now Glen Cove), Long Island, N. Y., Nov. 15, 1769, died in Princeton, Ind., May 30, 1845. In 1794 he entered the itinerant ministry of the Methodist Episcopal church, travelled and preached for four years in Connecticut, Vermont, and Maine, labored at Charleston, S. C., for a year or more, and thence was ordered to Baltimore, where he attended the general conference in May, 1800, and took a prominent part in favor of limiting the episcopal prerogative, a delegated general conference (his plan for which was finally adopted in 1808), and a preachers' anti-slavery tract society, and against the future admission of any slaveholder into the church. He afterward travelled with Bishop Asbury as his private secretary. In 1804-'6 he was stationed in New York, whence he removed to his farm on Longanore, Frederick co., Md. By his marriage he became the holder of slaves, whom he emancipated as soon as the law would permit (1820). From 1809 to 1814 he was again an itinerant, and was stationed successively in Baltimore, Georgetown, Alexandria, and on the circuit of his farm residence. While in Georgetown he was elected chaplain to congress. In 1829 he removed to Indiana. He was the first to introduce camp meetings into Maryland and New York. In 1821 he began to write in favor of lay representation. The refusal of this right by the general conference in 1828, and the expulsion from the church of many of its advocates, led to the formation of the Methodist Protestant church, in which Mr. Snethen bore a prominent part, and in connection with which he continued to travel and preach after his removal to the west till a short time before his death. He published "Lectures on Preaching the Gospel" (1822), "Essays on Lay Representation" (1835), and "Lectures on Biblical Subjects" (1836). A volume of his sermons, edited by Worthington G. Snethen, was published in 1846.

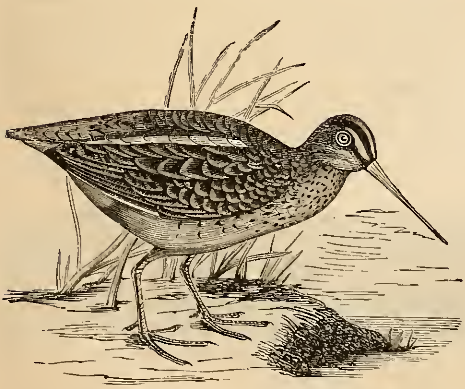
**SNEYDERS.** See SNYDERS.

**SNIPE,** a group of wading birds, of the subfamily *scolopacinæ*. It is characterized by a long, straight, slender bill, obtuse and flexible, covered with a soft, sensitive skin, abundantly supplied with nerves toward the end; the upper mandible the longest, somewhat bent down at the end, and grooved on the sides, in which the nostrils are placed; the tongue long, slender, and pointed at the end, the œsophagus narrow, and the stomach very muscular; eyes far back in the head; wings moderate and pointed; tail short and rounded; legs short, feathered lower down than in most waders; hind toe small, elevated, but reaching the ground, the anterior long and slender, and free except in the genus *macroramphus*. Snipes are migratory and small, going north to breed; they frequent marshy places and the margins of rivers and ponds, where they probe the soft mud perpendicularly with the bill in search of worms, insects, and larvæ; the nest is a slight hollow on the ground, lined with grass and sedge, and the eggs, usually four, are placed with the pointed end inward; the young are able to leave the nest as soon as hatched; the flesh is considered a great delicacy. The subfamily includes the genera *macroramphus* (Leach), *gallinago* (Leach), *rhynchæa* (Cuv.), *scolopax* (Linn.), and *philohela* (Gray), of which the last two will be noticed under WOODCOCK.—In *macroramphus* the wings are long and pointed, with the first and second quills equal; the tarsi are longer than the middle toe, which is united to the base of the outer by a short web. The species are found in Europe and North America, occurring in large flocks near the sea, feeding on small mollusks, worms, and insects; they fly rapidly and irregularly with a quivering whistle. The gray or red-breasted snipe (*M. griseus*, Leach) is about 10 in. long and 18 in. in alar extent, the bill 2¼ in., and weighs 3½ oz.; the prevailing colors above

are dark ashy, pale reddish, and black, with rump and upper tail coverts white; under parts pale ferruginous, with spots and bands of brownish black; the quills brownish black,

Wilson's Snipe (Gallinago Wilsonii).

the shaft of the first primary white; the young are dull white below, marked with ashy; the plumage is more gray in winter, and more red in summer. It occurs over temperate North America, in large flocks, occasionally going inland in autumn on the return from the north, where it goes to breed; the flight is rapid and strong, accompanied by a single mellow "weet;" the call note is a whistle; the flesh is not so good as that of the common American snipe.—In *gallinago* the tarsus is shorter than the middle toe, and there is no web. The American or Wilson's snipe (G. *Wilsonii*, Bonap.) is about 10½ in. long, with an alar extent of 17 in., the bill 2½ in., and weighs 3 oz.; above the feathers are brownish black, spotted and edged with yellowish brown or ashy white; a black line from base of bill over top of head;



Common European Snipe (Gallinago media).

throat and neck before reddish ashy, under parts white, quills and tail like back, the latter widely tipped with bright rufous, with a narrow subterminal black band. It occurs over temperate North America, going in summer as far as Nova Scotia, where it breeds in June in the elevated moss-covered marshes; the eggs are yellowish olive, spotted with brown; they return to the south in October, and are very fond of the rice fields; they rarely visit the seashore, and never the interior of woods; the cry resembles the syllables "wau-aik." They are fond of leeches and other food not generally coveted by man, though most epicures, ignorant of this, are in the habit of cooking and eating them, contents of intestines included. The great or double snipe of Europe (*G. major*, Steph.) is 11 or 12 in. long, varied with black and bright reddish above, the red arranged longitudinally, and whitish red below; the shaft of the first quill is whitish; it inhabits N. Europe. The common snipe of Europe (*G. media*, Steph.) is 10 or 11 in. long, with two blackish longitudinal bands on the head, the neck spotted with brown and fawn color, the mantle blackish with two longitudinal fawn-colored bands, the wings brown waved with gray, quill shafts brown, and lower parts white waved with blackish on the flanks; it flies very high, with a shrill cry; from its wavering flight it is generally difficult to shoot; its flesh is delicious.—In *rhynchæa* the bill is shorter and more curved, the first three quills equal and longest, the tertials as long as the quills, and the tail very short; the species are adorned with bright yellow ocellated spots on the quills and tail; they occur at the Cape of Good Hope, in the East Indies, and Australia. The Cape snipe (*R. Capensis*, Cuv.) is 10 in. long, variegated with black and cinereous; around the eye, a little way down the neck, pectoral band, and abdomen, white.

**SNOHOMISH,** a N. W. county of Washington territory, bordering W. on Puget sound and E. on the Cascade mountains, and drained by several streams; area, 1,500 sq. m.; pop. in 1870, 599. Extensive forests skirt the streams, and lumber is the chief source of wealth. Coal is found in various places. Along the sound are extensive cranberry marshes, and in the interior large tracts adapted to agriculture. The chief productions in 1870 were 1,290 bushels of oats, 1,415 of barley, 11,680 of potatoes, and 857 tons of hay. The value of live stock was $25,305. Capital, Snohomish City.

**SNORRI STURLASON,** or **Snorre Sturluson,** an Icelandic historian, born on the shores of Hvammsfiord, a bay on the W. coast of Iceland, in 1178, murdered at Reykholt, Sept. 22, 1241. He was of distinguished family, was carefully educated, and became proficient in Greek and Latin. Though originally poor, he became by marriage the wealthiest man in Iceland; and his legal attainments, bravery, and eloquence obtained for him the highest positions in the field and in the *althing* or legislature. His residence was a fortified stronghold, and he appeared in the national assembly with a retinue of hundreds of armed followers. Traces of his sumptuous abode at Reyk-

holt still exhibit stone structures of finished elegance for hot baths, supplied from boiling springs through an aqueduct of hewn stone 500 ft. in length. On being elected to the chief magistracy, he gave proof of great judicial learning. In 1213 he produced an ode to a Norwegian warrior, which was requited by liberal presents. This poem was followed by others, one of them composed in honor of the king of Norway, Haco V. On a visit to Norway he was made an honorary marshal of the court, and upon re-embarking for Iceland was loaded with rich presents. Faction and disorder prevailed throughout Iceland, and the king of Norway seized the moment to advance his designs for the subjugation of the island. Snorri became involved in domestic feuds, and in 1237 appeared in Norway as a fugitive. The king created him a jarl, but soon became hostile to him, and Snorri returned to Iceland. Emissaries were employed to seize him and send him in irons to Norway, but he was murdered at Reykholt by his son-in-law, Gissur. His most important work is the *Heimskringla*, or "Chronicle of the Norwegian Kings." It is probable that in this work he made large use of the writings of Ari Frode, fragments of whose Scandinavian histories, composed a century earlier, still remain. The Younger Edda also bears the name of Snorri Sturlason alone, but it was gradually formed by the successive additions of several writers. The first copy of it was found by Arngrim Jonsson in 1628. The original Icelandic text of the *Heimskringla* was first printed by Peringskiold in 1697, though a Danish translation was current 100 years before. The last edition is by Schöning and others, in Icelandic, Danish, and Latin (6 vols., Copenhagen, 1777–1826). There is an English translation, "The Heimskringla, or Chronicle of the Kings of Norway," by Samuel Laing (3 vols., London, 1844).

**SNOW**, the flocculent white masses of crystals in which the aqueous vapor of the atmosphere at low temperatures is precipitated from the clouds. The other forms in which atmospheric vapor appears are treated of under DEW, FROST, HAIL, and RAIN. The primary condition necessary to the formation of snow is the saturation of the air at a freezing temperature with vapor; the exact limits of temperature are not known, but probably vary with the density of the air and the vapor; the surplus vapor is precipitated from its invisible state in minute crystals, the primary form of which is that of a rhomboid having angles of 60° and 120°. (See CRYSTALLOGRAPHY.) By far the larger part of

FIG. 1. FIG. 2. FIG. 3. FIG. 4. FIG. 5.

snow falls during the night, and in many localities the maximum fall is between 1 and 7 A. M., which suggests that the cooling necessary to the production of snow is mainly due to radiation; a secondary maximum between 8 and 10 A. M. is explicable as due to the influence of the dynamic cooling of rising currents. The complexity of the forms of snow

FIG. 6. FIG. 7.

flakes increases with the quantity of moisture in the air, and probably with the variety of alternations of temperature to which they are exposed. Their size increases with the temperature and humidity; thus they are much larger from 9 to 11 A. M. than before sunrise. Little however is satisfactorily known on these points. More than 1,000 forms of snow crystals have been observed and figured

FIG. 8. FIG. 9. FIG. 10. FIG. 11.

by Scoresby, Glaisher, Green, Stephen Lowe, and others. A very beautiful contribution to this subject was published anonymously in New York in 1863, under the title of "Cloud Crystals," in which over 150 new forms are added to those described by previ-

ous authors, and several interesting observations are given upon the conditions of their formation. The accompanying figures, representing specimens of the simple and the more complicated forms of crystals, are from Buchan's "Meteorology." Scoresby, who first studied these forms, classified them into: 1, thin plates (figs. 1 to 7); 2, spherical nuclei studded with needles (fig. 8); 3, three- or six-sided prisms or needles (fig. 9); 4, six-sided pyramids (fig. 10); 5, prisms terminated by planes (fig. 11). The conditions regulating the occurrence of each figure are probably quite definite, inasmuch as it is rare that more than three or four kinds of flakes occur at the same time. The high cirrus clouds are probably generally formed of spiculæ, or possibly small flakes of snow, which when the clouds are not too thick give rise to the phenomena of halos (see Halo), and the geometrical explanation of these latter seems generally to require that the snow flakes present in these clouds should be principally of the simplest forms. The amount of snowfall in different parts of the earth is known with less accuracy than is that of rainfall, owing partly to the drifting of the snow, but especially to the fact that a too great diversity has existed in the methods adopted by the observers to ascertain either the quantity or the depth of the snow. It is generally assumed that $\frac{1}{10}$ or $\frac{1}{12}$ of the depth of snow measured immediately after falling will give the corresponding depth of melted snow. Quetelet, as the mean of many observations, says $\frac{1}{9}$, but for very dry or very wet snow these fractions are very uncertain. The total depth of snowfall is greatest, other conditions being the same, where the strong winds of winter are laden with moisture; thus it averages annually 4 to 7 ft. in the interior of Maine, Vermont, New York, and Upper Canada, but only 2 ft. for the states in the same latitude further west. One of the heaviest snowfalls recorded in America was that which continued from Feb. 19 to 24, 1717, when the snow remained 5 or 6 ft. deep over all the settled parts of New England. The geographical distribution of snow at sea level is such that in general in the eastern parts of North America and Asia it is rarely seen S. of lat. 30°, and in western Asia S. of lat. 36°. On the W. side of North America it is rarely seen at the sea level on the immediate coast, but is quite common in the interior.—Falls of snow may occur in any month in extreme polar latitudes; in New England and Canada snow falls mostly from November to March inclusive, but in the latitude of Washington, D. C., it falls mostly during January and February. The average number of days on which snow falls is, for St. Petersburg, 170; Paris, 12; Washington, D. C., 20; Gibraltar, 0; San Francisco, 0; Charleston, S. C., 1. But on ascending above the sea level we soon come to altitudes such that snow may fall and remain on the ground at any season; the altitude at which accumulations remain throughout the year is called the limit of perpetual snow. The conditions governing this lower limit were first studied carefully by Humboldt in his climatology of Asia, and more recently has been investigated by Grad (1873); according to these, the limit in question has a general apparent connection with the isotherms of 32° F., but departs therefrom to an important degree when the prevailing winds are dry or moist. Thus the limit is lower in the southern than in the northern hemisphere; lower on the S. than on the N. side of the Himalaya mountains; lower within the tropics than under the latitudes 20° to 35°. From these latitudes it diminishes, according to Grad, to about 3,000 ft. in lat. 60° S. and 65° N.; but only in the high polar regions is the limit below 1,000 ft., it being higher in Greenland or Spitzbergen, where it is only the glaciers that descend to sea level. (See Glacier.)—Owing to the innumerable reflecting facets of the minute crystals and the quantity of air caught between the crystals, a layer of snow is a remarkably perfect non-conductor of heat; for this reason the covering of snow on the ground forms an almost perfect protection to the plants beneath against the freezing that would otherwise follow the radiation of their heat into the atmosphere. In Ebermayer's "Influence of Forests" (1873) a case is quoted (by no means an extreme one) in which the temperature of the air was −6·8° F., and that of the surface of the earth beneath the snow +33·8° F., while below the surface the earth was still warmer. On the other hand, the individual crystals of snow have probably the same large radiating power as ice in larger solid blocks, which according to Leslie is 85, that of lampblack being 100. The consequence of this is, that during the night very hard frozen crusts are formed on the surface of the snow which has been somewhat thawed during the day; the same property, together with that of regelation, explains the peculiar structure of the surface snows of glaciers, and assists in the formation of areas of colder air over snow fields than over bare land. Equally important is the great absorptive power of snow for solar heat, since by reason of it the surface of a layer of snow is melted rapidly, and a large amount of moisture is thrown into the air, giving rise to extensive fog and haze, and having a decided influence on the development of storms.—Snow flakes in falling bring with them nearly all the fine dust floating in the air, leaving the atmosphere extremely pure; thus in northern Europe Nordenskiold has found freshly fallen snow impregnated with a black dust of carbon and iron such as could only have come from meteors; at other times the dust is such as could only have come from eruptions of volcanoes, especially those in Iceland.—Snow is occasionally tinged black, yellow, red, or green, as was known to Pliny. These colors are due to the presence of microscopic organisms, as was

suspected by De Saussure (1760), which were described by Dr. Wollaston as minute spherical globules having a transparent covering and divided into seven or eight cells filled with a red oily-like liquid insoluble in water. Girod-Chantraus (1797 and 1802) described these as plants under the name *volvox lacustris*. Bauer (1820) demonstrated that they are a fungous growth, which he named *uredo nivalis*. Robert Brown concluded them to be algæ allied to the *tremella cruenta*. Agardh confirmed the views as to their vegetable nature, and gave them the title *protococcus permesina*. Bravais and Martins, as members of the northern commission, verified the identity of red (*hæmatococcus nivalis*) and green (*protococcus viridis*) globules as being one and the same plants in different stages of growth, the green being probably the riper. The most recent authority on this difficult subject is Rostafinski (1875), who retains the generic name *hæmatococcus*, and has further confirmed the identity of these microscopic algæ. Ehrenberg (1847) found, besides vegetable spores, animalcules properly so called, among which the most abundant in red snow is that to which he gave the name *philodina roseola*.—The glare of the sunlight reflected from snow-covered ground gives rise, unless the eyes are protected by glasses or goggles, to a very severe inflammation of the optic nerve. (See Amaurosis, and Blind.)

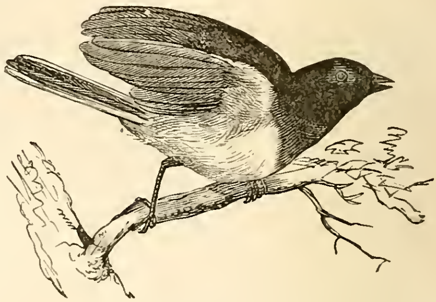
**SNOWBALL.** See Guelder Rose.

**SNOWBERRY,** the common name for a native shrub, given on account of its large, very pure white berries, which ripen in autumn and remain after the leaves have fallen. The genus *symphoricarpus* (Gr. συμφορεῖν, to bear together, and καρπός, fruit, from the clustered berries), to which it belongs, is exclusively North Amer-

Snowberry (Symphoricarpus racemosus).

ican, extending from British America to Mexico, and contains about six species; it belongs to the honeysuckle family, and differs from the honeysuckle (*Lonicera*) itself in having a regular corolla and a fewer-seeded berry. All are small branching shrubs, with ovate entire (or sometimes wavy-toothed), opposite leaves, and small, bell-shaped, four- to five-lobed, white or rose-tinted flowers in short spikes or clusters. The snowberry (*S. racemosus*) is found from Vermont westward to Oregon, and as far south as Pennsylvania; it is one of the most common garden shrubs, and is cultivated for its white berries. The wolfberry (*S. occidentalis*), growing from Michigan westward, has also white berries. The Indian currant or coralberry (*S. vulgaris*), found from western New York to Texas, and sometimes cultivated, has small dark red berries in dense clusters.

**SNOW BIRD,** a well known member of the finch family, and genus *junco* (Wagler). With the general characters of the finch family, the middle toe is shorter than the short tarsus, the outer the longest; the wings are rather short, and the tail slightly notched; the second quill is the longest. The common snow bird (*J. hyemalis*, Sclater) is about 6¼ in. long, and 9 in.



Snow Bird (Junco hyemalis).

in alar extent; the upper parts are nearly uniform dark plumbeous, darkest anteriorly, without any red in the interscapular region; lower parts white; the external two tail feathers white, the third white margined with black. It is found from the eastern United States to the Missouri and the Black hills of the west, and from Louisiana to the fur countries. It appears in New England from the south early in April, while the ground is covered with snow, going north to breed, and returning south late in autumn. They are found in small families, which usually keep by themselves, often visiting farm yards and hopping after domestic poultry, and in cold weather retiring into holes in hay stacks. They are fond of grass seed and berries; the flesh is delicate and juicy, and is often sold in the New Orleans market; the spring notes are agreeable. The nest is on the ground, the entrance generally concealed; the eggs are four, three fourths by five eighths of an inch, yellowish white with numerous small reddish brown dots. A nearly allied species in the Rocky mountains is the *J. caniceps* (Baird), having a reddish spot in the interscapular region but not on the wings. On the

Pacific coast is the *J. Oregonus* (Sclat.), head and neck sooty black, a chestnut patch on the back and wings, and the belly pure white.

**SNOW BUNTING.** See Bunting.

**SNOWDROP,** an early spring flower, the name being derived, according to Prior, from the

Snowdrop (Galanthus nivalis).

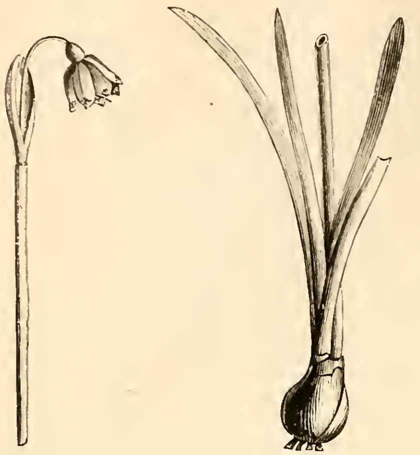
German *Schneetropfen*, which does not refer to a drop of snow, but, so far as the drop is concerned, to the pendents or ear drops worn by ladies in the 16th and 17th centuries. The genus, *galanthus* (Gr. γάλα, milk, and ἄνθος, flower), belongs to the amaryllis family, and consists of three or four European species. The small bulbs throw up two or three narrow leaves and a flattened scape which bears (usually) a single fragrant flower on a slender nodding pedicel; the perianth has six separate divisions, the three inner tipped with green and shorter than the three pure-white outer ones. The common snowdrop is *G. nivalis*, which, though very common in England, is supposed to be naturalized there; its leaves are very narrow, and its flower stalk 3 to 6 in. high; there is a double variety; the plant blooms early, often appearing in February. The Crimean snowdrop (*G. plicatus*) has the same general appearance as the common, but is larger in all its parts. The bulbs, which are small, should be planted in clumps, and bloom more satisfactorily if left undisturbed for several years. (For cultivation, see Hyacinth.)

**SNOWDROP TREE,** a name given to shrubs or small trees of the genus *Halesia*, on account of the pure white pendulous flowers, which have also suggested the equally common name of silver-bell tree. *Halesia* belongs to the storax family, and is a genus of two or at most three species, which have large, veiny, pointed, deciduous, alternate leaves without stipules; the flowers, in clusters or short racemes, open just as the leaves appear, from axillary buds of the previous year; the small calyx is four-toothed, its tube cohering with the ovary; petals four, united at the base or to the middle, forming a bell-shaped corolla; stamens 8 to 16, more or less united at the base; ovary two- to four-celled, becoming a large, dry, bony, two- to four-winged fruit with one to four cells, each of which contains a cylindrical seed. The best known species is the four-winged snowdrop tree (*H. tetraptera*), so called from the four wings to the fruit; it is found from Virginia southward; it sometimes reaches the height of 50 ft., but is more generally much smaller; the bark is dark-colored, marked by light fissures, which give it a characteristic netted appearance; the ovate-oblong leaves have glandular petioles, are 2 to 4 in. long, and finely serrate; the flowers have four-lobed corollas, nearly an inch long, with 12 to 16 stamens distinctly united below the middle. This tree is quite hardy in the northern states. The two-winged species (*H. diptera*) is more southern, and is found from the Carolinas southward; the larger leaves are coarsely serrate; the flowers are larger than in the preceding, and consist of four nearly distinct petals, and the 8 to 12 stamens are nearly distinct; the fruit, which is about an inch long, has only two wings; the tree does not grow so large as the other. This species is quite rare and difficult to find in the nurseries, forms of the preceding being confounded with it. Michaux described a third species, *H. parviflora*, which seems to be nearly unknown, if indeed it be not a form of one of the others. The trees are raised from seeds, which, unless sown as soon as ripe, lie in the ground a year before they germinate.

Snowdrop Tree (Halesia tetraptera).

**SNOWFLAKE,** a name said to have been invented by Curtis for *leucoīum vernum*, to distinguish it from snowdrop, to which it is nearly related and which it closely resembles. *Leucoïum* (the ancient Greek name) is a small genus of the amaryllis family, of three species, all of which are European; it differs from *galanthus* (see Snowdrop) in having one to seven flowers upon the scape, and the divisions of the flower are of equal length. In our catalogues *L. vernum* is the plant offered as snowflake, but the English designate this as spring snowflake, as summer and autumnal species are also sold more commonly than with us. The spring snowflake comes very early, and is much like

a large snowdrop, its scape, about 12 in. high, bearing a single, large, very fragrant, pure white flower, each division of which is tipped



Spring Snowflake (Leucoïum vernum), Flower and Bulb.

with green. The summer snowflake (*L. æstivum*) has a scape about 2 ft. high, with three to seven flowers about an inch long, blooming in late spring or early summer. The autumnal snowflake (*L. autumnale*, also called *Acis*) has narrow leaves and a scape 6 in. high, bearing two to three small flowers, which are pure white or suffused with rose, and appearing before the leaves in September. This is only a greenhouse plant here; the others are treated like other spring bulbs. (See Hyacinth.)

**SNUFF.** See Tobacco.

**SNYDER,** a central county of Pennsylvania, bounded E. by the Susquehanna river; area, about 260 sq. m.; pop. in 1870, 15,606. The surface is hilly and the soil fertile. Iron ore and coal are found in great abundance. It is traversed by the Pennsylvania railroad, and the Pennsylvania canal passes along the E. border. The chief productions in 1870 were 247,381 bushels of wheat, 12,752 of rye, 255,831 of Indian corn, 283,841 of oats, 73,889 of potatoes, 4,762 of clover seed, 18,939 tons of hay, 9,366 lbs. of wool, and 241,246 of butter. There were 3,964 horses, 3,900 milch cows, 4,489 other cattle, 3,367 sheep, and 9,050 swine; 3 manufactories of carriages and wagons, 11 of tanned and 10 of curried leather, 21 flour mills, and 8 saw mills. Capital, Middleburg.

**SNYDERS, Sneyders, or Snyers, Francis,** a Flemish painter, born in Antwerp in 1579, died there in 1657. He is celebrated for his pictures of animals and hunting scenes, excelling in those which represent violent action. He produced many pictures jointly with Rubens, Jordaens, and others, they executing the human figures and Snyders the animals.

**SOAP** (Gr. σάπων, Lat. *sapo*), a compound formed by the union of alkalies with oils and fats. The invention of soap is ascribed by Pliny to the Gauls, and he gives the Germans credit for manufacturing both hard and soft soaps. From them the Romans learned the art, but soap was for a long time principally used by them as a wash for the hair. A complete soap-boiling establishment, and soap in a good state of preservation, have been discovered at Pompeii. Some natural productions possess the qualities of soap, as the berries of the soap tree (*sapindus saponaria*) of South America and the West Indies, and the bark of the *quillaja saponaria*, which has been carried from Peru to Liverpool for washing woollens. The juice of soapwort or bouncing Bet (*saponaria officinalis*) forms a lather with water, and is used in England for scouring dresses. In California the roots of the *phalangium pomaridianum*, which grows there abundantly, and has the odor of brown soap, is much used for washing clothes. Alkaline waters, when used upon greasy fabrics, form soaps similar to those produced in the regular manufacture. Different kinds of oils may be used in soap making, having different proportions of the proximate principles of fatty bodies, stearine, palmitine, and oleine (see Oils and Fats), and also upon the kind of alkali, soda making a harder soap than potash. The hardest soaps are made with stearine and soda, the softest with oleine and potash. The natural combination of glycerine with the fatty acids is broken up by the action of the alkali, and the glycerine exists in a free state in the soap, or it may be extracted as a separate product. The principal fats and oils used for making soap are tallow, and palm, cocoanut, rape, poppy, linseed, hempseed, and olive oils; the last is used in the manufacture of the celebrated Castile, Marseilles, and other marbled and plain soaps of southern Europe. The best oils for marbled soaps come from Naples, and the Spanish oils are also highly esteemed. The oils from the East are not so rich in stearine, and are more or less colored green, which is objectionable. The mottling or marbling of soaps is produced by sprinkling the surface of the newly made body successively with lyes of less and less concentration, by which the soap is again rendered sufficiently pasty or semi-fluid to allow of the aggregation in different masses of the particles of coloring matter.—The ordinary method of saponification, as the conversion of fats into soaps is called, is by boiling them with solutions of caustic potash or soda. Most fats require long continued boiling with excess of alkali, but others, as lard, beef marrow, and oil of sweet almonds, may be saponified by agitation with caustic alkali at ordinary temperatures; and under increased pressure the alkaline carbonates will readily produce saponification of fats. Rosin, which is capable of forming a soap with either potash or soda, is frequently added to soaps. Every kind of soap contains a variable quantity of water, partly

in chemical combination. Soap is perfectly soluble in alcohol and hot water, but both solutions solidify to a jelly at a certain stage of concentration. Opodeldoc is soap mixed with alcohol in this state, to which camphor is added. Cold water does not dissolve the alkaline oleates, palmitates, and stearates which constitute ordinary soap, without decomposition, the alkali being dissolved and the oily acid precipitated; and when hot solutions are cooled the same action takes place. Soap is quite insoluble in a solution of common salt containing more than one part in 400 of water, so that on the addition of salt to the contents of a soap pan, a curd consisting of a solid soap will rise to the surface, while the alkaline salts and glycerine remain dissolved in the water. Some soaps, as those made from cocoanut oil, are not so easily separated from their solutions by common salt. Other chlorides, as those of potassium and ammonium (sal ammoniac), have a similar action to that of common salt. Soaps are scented and colored by mixing coloring matter and volatile oils or odorous matters with them. They are sometimes medicated with antiseptic and other substances, such as creosote, carbolic acid, chlorate of potash, and sulphur, and are used as detergents and in skin diseases. Arsenic is sometimes added to soap and used by taxidermists in preserving their preparations. Those medicinal preparations called liniments are soaps whenever they are made by the mixture of an alkali or an alkaline earth with an oil. Silicate of sodium (soluble glass) may be mixed with soap and used with advantage as a domestic cleansing agent. Soaps mixed with fine sand or pumice stone do not possess the same detergent properties, but are useful for scouring. The manufacture of soap is more largely carried on in Great Britain than in any other country, although great quantities of toilet soaps are made in France, especially for the American market. The annual product of Great Britain is often considerably over 200,000,000 lbs. The manufacture is also carried on to a considerable extent in the United States, and some fine toilet and other soaps are made.—The history of soap may be found in Beckmann's "History of Inventions;" its technology in Parnell's "Chemistry applied to the Arts," Knapp's "Chemical Technology," Wagner's "Chemical Technology," Muspratt's "Chemistry," Morfit's "Applied Chemistry in the Manufacture of Soaps and Candles," and in "A General Treatise on the Manufacture of Soap," by H. Dussauce (8vo, Philadelphia, 1869). The French manufacture is described in one of the *Manuels Roret* entitled *Nouveau manuel théorique et pratique du savonier, ou l'Art de faire toutes sortes de savons* (Paris, 1852).

**SOAPSTONE.** See Talc.

**SOBIESKI.** See John III. Sobieski.

**SOCIALISM,** the doctrine that society ought to be reorganized on more harmonious and equitable principles. Communism and coöperation are its principal divisions or varieties. Communism and socialism are sometimes used as synonymous; but generally the former term specially refers to the plans of social reform based on or embracing the doctrine of a complete community of goods. Coöperation is understood to be that branch of socialism which is engaged exclusively with theories of labor and methods of distributing profits, and which advocates a combination of many to gain advantages not to be reached by individuals. Viewed as a whole, socialistic doctrines have dealt with everything that enters into the life of the individual, the family, the church, or the state, whether industrially, morally, or spiritually. The origin of all is to be sought in the desire to ameliorate the condition of the less favored classes, and in the attempt to overcome by association the deprivations to which individuals, especially those without rank, culture, and capital, are exposed. After many experimental attempts in recent times to effect a radical modification of society in all its parts, the simplified socialism of the present day mostly aims only to protect the laborer in his rights, or to shield him against the oppression of capitalists.—The history of socialism runs parallel with that of property. Wherever the power of individual proprietors became oppressive, communistic doctrines usually arose. Such was the origin of the schemes of the ancient Greeks. Phaleas of Chalcedon expected gradually to remove the disparities of property by making a law that the rich should give but not receive dower in marriage; and in order that none should be intellectually superior to others, he desired that all should receive the same education. Plato's ideal republic was to consist of three classes: the educated, who are the law makers and rulers; the common people, including agriculturists and other laborers; and the soldiers. The state was to assign to every one his rank and sphere of activity; the soil was to be the property of all, and its fruits were to be equally shared by all. The women also were to be common property, as well as the slaves. Communistic doctrines more or less evolved from peculiar religious views, and advocating the founding of isolated communes, existed among the ancient Hindoos and Egyptians. Among the earliest attempts at socialistic life was that of the Jewish sect known as the Essenes, who had established themselves on the western shores of the Dead sea about the 2d century B. C. Though there are few trustworthy accounts of their teachings and practices, it may be accepted as certain that they held their property in common, and discountenanced marriage, without really prohibiting it. (See Essenes.) The Carpocratians, an early Christian sect, which continued to exist until the middle of the 6th century, also practised community of goods and of women. Many features of the monas-

ticism of the middle ages are more or less communistic. Societies of women were formed for the relief of the sick and poor in the 11th century, possessing at first nothing of the later conventual type. They had clusters of houses and gardens, whose inmates supported themselves by their own labor, grouped round a hospital and similar institutions. In time the dormitories, refectories, and work rooms were also occupied in common. Such was the origin of the beguinages of the Netherlands. Later, various ascetic communistic societies arose, as the "Brethren and Clerks of the Common Life," founded by Gerard Groot about 1378 in the Netherlands, whose members, chiefly priests, supported themselves by manual labor and by teaching and preaching. Along with these existed communities whose members indulged in the wildest license, and were finally extirpated by the authorities; such were the Adamites, who walked about naked and had a community of wives. At the reformation a communistic tendency was wide-spread in Germany, and it led to a revolt of the serfs against their lords, a movement of social reform avowedly based upon the doctrines of the New Testament. (See PEASANTS' WAR.) Some of the Anabaptists, the movements begun by Storch and Münzer (see MÜNZER), the familists, the levellers, and numerous other fanatical sects of this period, all show more or less of the same spirit of hostility to the rich, of a desire for a better distribution of property, and a struggle to realize an ideal social state. In the same period appeared the first works which, depicting a more or less fanciful or ideal community, may be considered the precursors of the more recent scientific socialistic schemes. The first edition of Sir Thomas More's "Utopia," an account of an imaginary commonwealth, where there are only good and happy citizens and the government is perfectly paternal, was printed in Latin at Louvain in 1516, and it was soon translated into English, French, Dutch, and Italian. Another Utopia was depicted by Campanella in his *Civitas Solis* (1623). A vast hierarchy of officials assign and direct the duties of the people; four hours a day are devoted to labor, the women performing the lighter tasks; the rest of the day the people are trained in philosophy and the sciences. Similar schemes were sketched by Hall in his *Mundus Alter*, Fénelon, Morelly, Defoe in his "Essay on Projects," and Bacon in the "New Atlantis." In 1656 Harrington published his "Oceana," of which Hume said that it was the most valuable model of a commonwealth hitherto offered. The first complete plan of an industrial community intended for immediate adoption was John Beller's scheme of a "College of Industry" (1696). The shareholders were to divide among themselves the profits of the college, but the laborers were to be guaranteed all things necessary in case of sickness, for the education of their children, for the maintenance of their widows, and the like. In France there have been at various times small communities in which work was divided according to the capacity of the members, who received equal shares of the profits, and elected a master of the community, vested with full power of command, and constituting their legal representative. In the United States there are about 70 communistic societies, all based on a religious belief of some form. The Shakers were established in the northern states about 1780, and in the west about 30 years later; the Rappists were established in 1805, the Zoarites in 1817, the Eben-Ezer or Amana communists in 1844, the Bethel community in 1844, the Oneida Perfectionists in 1848, the Icarians in 1849, and the Aurora commune in 1852. Though the Icarians reject Christianity, yet they raise to the position of a creed their doctrine of brotherly love, or their communistic idea. In the Bethel and Aurora communes unselfishness takes the place of a religious system. Community of women is practised only by the Perfectionists (see NOYES, JOHN HUMPHREY); the Shakers and Rappists are celibates; and at Icaria, Amana, Aurora, Bethel, and Zoar the family relation is held in honor. Only the Perfectionists are of strictly American origin; the principles of the Shakers, though first established here, originated in England; the Icarians are French, and the others are German. The Shakers are the most numerous.—After the reign of terror in France, Babeuf and his friends formed a conspiracy to overthrow the state. They taught that all men had equal rights in all property and in the enjoyment of it; every exclusive appropriation of the soil or of a branch of industry was a crime; all persons should receive the same kind and degree of education; the functions of the government should be to superintend the division of labor, the collecting of the produce in public stores, and the distribution of it to communities and individuals. The marriage relations and religious subjects were not specially discussed by them. Babeuf perished on the scaffold, and his doctrine seemed to have perished with him; but in 1834 Buonarotti revived it, and by means of pamphlets and the *Moniteur Républicain*, the *Homme Libre*, and other journals, it was again propagated. After some vain attempts at instituting social equality by insurrectionary means, the Babeuvists were content to continue as secret organizations, many of them developing the original doctrine, and the *travailleurs égalitaires* going to the extent of abrogating marriage as being a species of personal property, of wishing all towns destroyed as the natural hotbeds of tyranny, &c. In opposition to the *travailleurs égalitaires* Cabet (1788–1856) wrote his *Voyage en Icarie*, advocating a comparatively innocent communism, a small model of which he established in this country.—Saint-Simon (1760–1825) gathered about him men of science, and travelled in or-

der to enlarge his views; gave balls, dinners, and festivals, to extend his knowledge of mankind; and finally, when his wealth had been scattered, found himself abandoned to the most painful privations. He was thus fitted, as he thought, by a trial of all the conditions of humanity, to become their exponent and their reformer. He contrived what he denominated a new Christianity, or a scheme for the reconstruction of the religion, politics, industry, and social relations of mankind. To each man according to his capacity, to each capacity according to its works; such was the grand formula of the St. Simonian gospel. But the author did not live to witness its propagation. It was reserved for Rodrigues, Enfantin, Bazard, Buchez, and others to disseminate it over France. By their lectures and a journal established by them called *Le Producteur*, it soon gained many disciples, and at one time seemed on the point of absorbing the best youthful mind of the nation. Many men, who have since attained distinction as statesmen and men of letters, took part in the famous expositions of the rue Taranne, Paris, where the new school had its academy. But Saint-Simon had left his doctrine in the vague state of an aspiration or a sentiment rather than a system. His followers began to differ when they began to define. Sects arose in the bosom of the new faith. A common family was established in the rue Monsigny, but the order of functions had not been arranged in a satisfactory way. An open quarrel between two of the chiefs, Enfantin and Bazard, led to other dissensions. The finances of the general association failed, and the police interfered with its meetings, which had become, in consequence of the vivacity of the discussions and the appearance of women on the tribune, more attractive than the theatre. Enfantin collected his friends again at a patrimonial estate which he held at Ménilmontant, where a multitude of laborers were organized into groups of industrials, artists, priests, &c.; but the experiment could not be made to pay, Enfantin was seized and imprisoned, and the new family gradually dispersed. In spite of its want of practical success, the school of Saint-Simon exercised and continues to exercise a powerful influence over the French mind.—Charles Fourier (1772–1837) saw very clearly what his predecessors had not seen, that society was a growth, and not a construction; he saw that as it had followed fundamental laws of development in the past, so it must follow the same laws in the future; these laws, he also discerned, must be in analogy with the other laws of the living universe; and he concluded that the science of society must be the flower and consummation of all other sciences. But not satisfied with these grand generalizations, and the practical applications to which they inevitably lead, he assumed the character of a universal social philosopher and legislator, and lost himself in magnificent *a priori* speculations as to the formation and propagation of worlds, and the future destinies of all humanity. His vigorous thought procured him many disciples in France, England, and the United States; many efforts have been made to reduce his more practical maxims to practice, but no signal or decisive result has anywhere been achieved. (See Fourier.)—While Fourier and his disciples intended to carry out their socialistic reforms by their own exertions and without receiving any material aid from the government, Louis Blanc wanted the government to undertake the regeneration of society by the "organization of labor," holding that the evils of large capital and destructive competition could and ought to be cured by means of the state, the largest capitalist of all, from which every laborer that needs it has a right to demand employment (*droit au travail*). The government should purchase or gradually absorb the large industrial institutions of the country, and eventually render it more profitable to every laborer to join the large governmental workshops than to follow his calling on his own account. The wages of all laborers should be equal. As soon as the state had succeeded in becoming the only and general controller of production in the country, and the workmen had had sufficient opportunity to appreciate the abilities of individuals among them, the governmental administration should be superseded by the self-government of the laborers, on democratic principles. Louis Blanc opposed to the maxim of Saint-Simon, "To each according to his ability," his own, "From each according to his ability, to each according to his need." The revolution of 1848 put him in a position to experiment with his scheme. The provisional government erected public workshops, and paid wages to hundreds of thousands of laborers; but these were productive only of confusion, and contributed toward the socialistic insurrection of June, which ended in a crushing defeat.—Proudhon (1809–'65) desired to carry out his reforms without the aid of the state, and argued in opposition to Louis Blanc that the state not only should not, but could not inaugurate new social systems. In fact, Proudhon was opposed to systematic socialism of any sort. Though himself a Utopian, he combated the Utopias of everybody else. The infallibility which he claimed for his own doctrines he rendered still more odious in the eyes of his opponents by his peculiar manner of expressing his ideas. In one of his earlier principal publications, *Qu'est ce que la propriété?* (1841), he seemed to attack all property as being a kind of theft, while his intention was only to demonstrate the illegality of incomes received without labor. Similarly, his expression that he wanted to reduce the state to "anarchy" utterly obscured his real meaning, which was that the artificial centralization of the French government should give way to a government controlled by the masses. Like most socialists, Proudhon considered the

application of justice in the distribution of the wages of the labor and the profits of the capital employed in production to be the most important problem of political economy. The means proposed by him for making wages and profits proportional to each other were, that each citizen should unite in his own person the four necessary factors of production: laborer, capitalist, merchant, and employer. To bring this about, he held that employment should be guaranteed to the laborer, and that there should be a reorganization of the credit system, which he himself attempted by establishing the *banque du peuple* in 1849. This bank was an association of 20,000 laborers, who pledged themselves to take the paper issued by it in lieu of cash. Proudhon believed that a conventional sign of this sort, costing but little labor to produce, could take the place of gold and silver coins, the production of which requires a large amount of labor. The bank advanced to any member, on articles produced by him, four fifths of their value in its own notes, and demanded no interest for the loan. On security being given, it would advance upon work not yet done. Proudhon expected that this gratuitous credit, enabling men to consume at any time the wages of their labor, would be the means of inciting the members of the association to as great industry as the hope of accumulating interest-bearing capital, since their means of present enjoyment would depend upon their energy. The government soon closed the bank for violation of the laws of trade, and Proudhon's followers maintain that his scheme has never had a fair trial.—Robert Owen (1771–1858), in England, was arousing the public mind to the necessity of a new order of society at the same time that Saint-Simon and his disciples were preaching in France. They proceeded, however, on wholly different grounds. Owen's fundamental axiom was that man was made entirely by his external circumstances, so that, to form his character, and to produce his entire happiness, nothing was requisite but a change in his external relations. Possessed of great wealth, he established a manufacturing colony at New Lanark, in which his principles were applied to the laboring classes. Justice in the payment of labor, vast domestic economies, and a thorough system of infant and adult education gave it for a time great and increasing prosperity. Statesmen and churchmen alike admitted the success of the attempt, and the system, or parts of the system, were in a fair way of being introduced into other manufacturing districts. But Owen was encouraged by the promise of his plans to step forth as a philosopher. He taught in pamphlets, speeches, letters, and books, his doctrine of the omnipotence of circumstances and of human irresponsibility, attacking at the same time all religions and all governments, and thus provoking the earnest hostility of the clergy as well as of politicians. Other establishments were subsequently erected at New Harmony, Indiana, and Orbiston, Scotland, but they failed. His popularity declined rapidly, except among a portion of the laboring classes, and he accomplished nothing beyond his earlier success. He had travelled over the world to indoctrinate it with his principles, but the world remained to the end of his life stubbornly incredulous. Nevertheless he has a just claim to be considered the originator of modern coöperation.—In 1869 England alone numbered 1,308 coöperative societies, under general regulations prescribed by act of parliament; 749 of these sent in their returns to government at the end of 1870, from which their condition appears to have been as follows: number of members, 249,113; share capital, £2,034,261; loan capital, £197,128; average stock in trade during the year, £912,127; value of buildings, fixtures, and land, £962,276; dividend to members, £467,164; to non-members, £16,523; allowed for educational purposes, £3,775. The most successful experiment of the English coöperators is that of the Rochdale "Equitable Pioneers' Society," established mainly on the principles of Owen. Its primary object was the founding of a store for the sale of the necessaries of life, which was opened in December, 1844. In 1847 the pioneers opened a drapery department, in 1850 a slaughter house, in 1852 shoemaking and tailoring establishments; and after a history of continuous success, in the last quarter of the year 1870 they numbered 5,560 members, and had a share capital of £81,232. Similar stores and associations now exist in various parts of Europe, America, and Australia. The varieties of coöperation so far developed are numerous, but they are all founded upon the original idea of associated as opposed to isolated efforts. The power which the joint-stock principle places in the hands of small capitalists, the coöperative system places in the hands of the smallest capitalists; it even enables the man without capital to accumulate it. Morier describes coöperation as "the child of socialism, rescued by the economists from the dangerous custody of its parents." In Germany this movement on the part of the laborers was urged forward by Schulze-Delitzsch in opposition to the socialism of Lassalle and Marx, which led to the formation of the "International Association." (See International Association.) Schulze-Delitzsch originated a new form of coöperation, which has been successful in Germany to an extraordinary degree. He devised a people's bank, or coöperative credit bank, from which the members can borrow small sums up to 1,000 thalers. The capital is derived from the entrance fees and subscriptions of the members. The shares are fixed at 40 thalers, and may be paid by instalments. A 40-thaler shareholder may borrow 60 thalers without security; money is borrowed by the society at a low rate of interest; members on leaving receive the amount paid up on their shares, and are relieved from all liabilities after two years.

In 1870 the number of loan or credit banks in Germany was estimated at 2,000, and numerous associations of a similar nature are now established in Russia, Denmark, Italy, France, and England. There is in Germany a political party of socialists called *Socialdemokraten*, another development of the same movement which produced the international association, mainly composed of workingmen and their friends. This party aims to establish complete liberty, equality, and fraternity, by uniting all the working classes in associations, and securing to all the same rights and opportunities to work; there are to be no favored classes or individuals, and the whole world is to form one great solidarity. The so-called *Kathedersocialisten* are not socialists in the ordinary sense of the word, but a school of political economy opposing the free traders.—See, besides the works named in the biographies of the principal socialists, Stein, *Der Socialismus und Communismus des heutigen Frankreich* (Leipsic, 1844), and *Geschichte der socialen Bewegung in Frankreich* (3 vols., Leipsic, 1849–'51); Bluntschli, *Die Communisten in der Schweiz* (Zürich, 1843); Schäffle, *Kapitalismus und Socialismus* (Tübingen, 1870; English translation by Kaufmann, London, 1875); Noyes, "History of American Socialisms" (Philadelphia, 1870); Dühring, *Kritische Geschichte der National-Oekonomie und des Socialismus* (Berlin, 1871); Le Play, *L'Organisation du travail* (Paris, 1871), and *La réforme sociale en France* (Paris, 1872); Nordhoff, "The Communistic Societies of the United States" (New York, 1875); and Holyoake, "History of Coöperation" (London, 1875).

**SOCIETIES, Literary and Scientific.** The origin of this distinctive title for private intellectual associations is as ancient as that of academies. (See ACADEMY.) Societies existed in antiquity and in the middle ages, and in Germany and the Netherlands they acquired importance in the 15th century by promoting classical culture. The associations or corporations of the Meistersingers flourished till the 16th century. The 17th century witnessed the formation of bodies in Germany for the improvement of the language, after the model of the Florentine La Crusca and the French academy, and the rise and progress of scientific societies, especially of the "Royal Society of London," incorporated in 1663 for the investigation and advancement of physical science. Many important societies were formed in Great Britain in the 18th century, including the "Society of Antiquaries" (London, 1717), the "Royal Society of Dublin" (1731), "Royal Society of Edinburgh" (1783), "Medical" (London, 1773), and "Linnæan" (1788); and in 1800 sprang up in London the "Royal Institution of Great Britain," celebrated for chemical and other lectures. (See LONDON, vol. x., pp. 604–'5.) The subsequent increase of learned bodies was still more rapid. The United Kingdom now has societies for almost all branches of science, letters, learning, and art; and with a view of establishing greater unity, the royal society of London, and the astronomical, geological, Linnæan, and chemical societies, are to meet, after the completion of the palace of learning in the new Burlington house, in the same building, which is also to contain their extensive libraries, collections, and reading rooms. Most remarkable for stimulating many of the important discoveries of the century are the "Geological Society" (1807) and the "Royal Geographical Society" (1830). Those engaged in antiquarian and archæological researches also display great vigor; and special bodies, as for instance those relating to explorations in Palestine, have achieved signal results. Among other peculiarly valuable institutions are the "Royal Astronomical Society" (1820), which is one of the most important of the kind; the "Statistical Society" (1834), which throws much light upon the national resources; and the "Royal Asiatic Society of Great Britain and Ireland" (1823), with branches in Bombay, Madras, Hong Kong, and elsewhere. The "Royal Asiatic Society of Bengal," at Calcutta, dates from 1784. There are learned societies in other parts of the East, in Canada, Australia, and in almost every important part of the British empire; and all the leading societies publish the results of their labors. The most important English perambulatory body is the "British Association for the Advancement of Science," founded in 1831. (See ADVANCEMENT OF SCIENCE.) The "National Association for the Promotion of Social Science" held its first public meeting at Birmingham, Oct. 12, 1857, under the presidency of Lord Brougham. It embraced originally the five departments of jurisprudence, education, punishment and reformation, public health, and social economy; and a sixth department relating to trade and international law was added in 1860. The annual meetings are held at a different place each year, and are chiefly occupied in reading disquisitions and in discussions.—The continent of Europe emulates England in encouraging explorations, and this is especially the case with the geographical societies of Berlin, St. Petersburg, and Vienna, and the "Institute" at Gotha. In France and Italy the number of societies is diminished by the omnipotence of the academies. The former country, however, has several of importance, especially the *société géographique* of Paris, which publishes a celebrated monthly *Bulletin*, and the *société asiatique*, which has called into existence oriental societies in Germany and England. In the latter part of last century Germany had a poets' union (*Göttinger Dichterbund* or *Hainbund*) among its societies, with Klopstock at its head. In the present century it has initiated scientific congresses and other associations in the interest of political and social science, and the country abounds with societies devoted to every branch of knowledge, art, and industry. Among the oldest is the *Wissen-*

*schaftlicher Verein* at Göttingen (1750), and the best known are devoted to natural history and geology, especially in Berlin. Switzerland, Austria, Hungary, Russia, Holland, Belgium, and the Scandinavian countries have various learned bodies apart from the academies. They abound also in the United States, especially in regard to investigations of local and national history, nearly every state having a historical society with a library. The "New York Historical Society" (founded in 1804) and the "New York Geographical Society" (1852) are described under New York, vol. xii., p. 404. The most important society in the United States is the "American Association for the Advancement of Science," founded in 1847. (See Advancement of Science.) A "Social Science Association," organized in Boston in 1865, had in 1874 about 300 members.

**SOCIETY ISLANDS**, a group in the S. Pacific ocean, extending between lat. 16° and 18° S., and lon. 148° and 155° W.; area, 666 sq. m.; pop. about 18,000. The group is formed of two clusters of islands, one of which lies about 70 m. N. W. of the other. They were formerly, and by some geographers still are, distinguished by the separate designations of the Society islands (proper) and the Tahiti or Georgian islands. The latter are under the French protectorate; area, 453 sq. m.; pop. 13,800, of whom about 970 are emigrants, 400 soldiers, and 600 foreign residents. The former are independent; area, 213 sq. m.; pop. about 4,000. Mariners usually speak of one cluster as the windward and the other as the leeward, applying the term Society islands to both combined. The Society islands, thus defined, exclusive of several islets, are Tahiti or Otaheite, Eimeo, Maiaoiti, Maitia, Tetuaroa, Huahine, Raiatea, Otaha or Tahaa, Borabora, Marua or Maupiti, and Tubai, the first five belonging to the Tahiti group, and the remainder to the Society islands proper. The islands are mountainous in the interior, the highest peak, on the island of Tahiti, reaching an elevation of 7,339 ft., and have a border from 1 to 5 m. wide of rich level ground extending from the base of the high lands to the sea. In general appearance they are alike, and lava, basalts, and pumice stone, which are found in several places, indicate that their origin was volcanic. They are surrounded by belts of coral rock, of various width, situated from a few yards to 5 m. from the shore, with openings which permit the passage of canoes, while some of them admit ships to smooth water and good anchorage. There are small lakes and lagoons in some of the islands, and all are watered by numerous streams, upon the banks of which, or along the shores, the inhabitants reside.—There is considerable variety of soil, the sides of the mountains being frequently covered with a thin layer of light earth; the summits of many of the hills have a thick stratum of red ochre or yellow marl, while the soil of the level tracts along the shores is a rich alluvial deposit, mixed with vegetable mould, and is exceedingly fertile. The climate is healthful and very mild, the range of the thermometer throughout the year being inconsiderable. Besides the breadfruit, these islands produce almost every tropical vegetable and fruit, including some peculiar to the group. A few fruits and vegetables have been introduced from the temperate regions. The guava shrub, brought from Norfolk island, is now common, and bears a profusion of fruit, upon which pigs and cattle feed with avidity. Garden produce is little cultivated, and agriculture is very backward. A botanic garden, established by the French, offers seeds to colonists and natives; but there is little demand for them, and prizes offered to stimulate production were withdrawn in 1865 as useless. The spontaneous production of fruits seems sufficient for the natives. An Anglo-Portuguese agricultural company, established in 1861 for the cultivation of cotton and coffee by Chinese coolies, has effected but little. The introduction of limes and oranges has been very successful. Pigs, dogs, and rats were the only quadrupeds found upon the islands at the time of their discovery; but all our domestic animals have been introduced, and with the exception of the sheep and rabbit have thriven remarkably well. Horned cattle are abundant. There are numbers of aquatic fowl; the albatross, tropic birds, and petrel are found on all the islands; herons and wild ducks frequent the lakes and lagoons; and there are several kinds of birds of prey, woodpeckers, and small paroquets. Domestic fowl are abundant, and were upon the group at the time it was discovered.—The natives belong evidently to the Malay race, and are generally above the middle stature. Their countenances are open and prepossessing, though their features are bold and sometimes prominent. Their complexion is olive or reddish brown, but there are great varieties of shades. The appearance of the men is vigorous and graceful, and their behavior affable and courteous. Tattooing is not now practised. The native costume has been altogether abandoned for dresses resembling those worn by civilized nations. The native manufactures have been entirely superseded by imported goods. The chief intercourse is carried on with Valparaiso, Sydney, and San Francisco, and the domestic exports of the group consist principally of cocoanut oil, arrowroot, sugar, and pearl shells. The annual exports amount to about $1,000,000, and the imports to about $650,000. The principal port, Papiete in Tahiti (pop. about 800), is the residence of several foreign merchants. It is a free port except for arms and spirits, has a dock for repairing vessels, government buildings, and a hospital; and two newspapers, one in the native language and one in French, are published.—The Spaniards lay claim to the discovery of Tahiti in 1606, by Quiros, who called the island Sagittaria. Capt. Wallis, in a British ship sent to make discoveries in the South sea,

reached Tahiti in 1767, and named it King George's island. Bougainville touched at it in 1768, naming it Nouvelle Cythère. Capt. Cook reached it in 1769, discovered most of the islands in the N. W. cluster, gave to the whole group the name of Society islands, in honor of the royal society of London, and restored the native name to Tahiti. The Spaniards attempted to colonize Tahiti in 1772–'4; and about that date Cooke visited the group a second time, and again on his last voyage in 1777, when he found a house and cross which the Spaniards had erected carefully preserved by the natives. After this 11 years passed without any communication between the Society islands and the rest of the world, when the Bounty arrived to transport plants of the breadfruit tree to the British West India islands. The interest excited by these voyages resulted in the formation of the London missionary society, which fitted out a ship to carry missionaries into the islands of the Pacific. This vessel arrived at Tahiti early in 1797. For a long time the labors of the missionaries were fruitless, till Pomare II. embraced Christianity about 1815. Pomare died in 1821, and during the minority of his son the missionaries acquired great influence; but the son having died before he attained manhood, he was succeeded by Queen Aimata or Pomare, the latter being the surname of the reigning family. From the conversion of Pomare II. the power of the missionaries continued increasing, till it became paramount in Tahiti. The success of the French Catholic missions on the islands to the east induced two priests to go to Tahiti. The English missionaries opposed this, and the priests were forcibly deported. The French government then sent a frigate to demand liberty for all French subjects, and $2,000 as the expenses of the voyage to France of the expelled missionaries. In 1843 a strong force landed on Tahiti and hoisted the French flag, taking possession in the name of Louis Philippe. (See Du Petit-Thouars.) The queen made her escape to a neighboring island, and several skirmishes took place between the natives and the invaders. There was also a protracted diplomatic dispute with England, which ended in the payment of an indemnity by the French government for the expulsion of the British consul Pritchard and the seizure of some of his property. In 1846 the French power was completely established in Tahiti. Pomare was recalled, and a treaty was entered into, by which she was restored to authority, and the whole of her dominions placed under the protection of France. Capt. Cook, from the crowds which collected on the coast, supposed the population of Tahiti to be 80,000; but the first missionaries estimated it, along with that of the neighboring island of Eimeo, at 10,000. A census by the French in 1864 made the population of Tahiti, Marua, Tetuaroa, and Maiaoiti, 13,847. The reduction from former years is due to infanticide, venereal disease, smallpox, and rum. Attempts have been made to increase the population by immigration. A few hundred Chinese coolies have been introduced, and the French deported convicts from New Caledonia, but were obliged to withdraw them in 1864, on account of their demoralizing influence upon the natives. By the labors of the missionaries the moral and social condition of the latter has been much improved, and education is extending. In 1865 school districts were established, with two schools, one Protestant and one Roman Catholic, in each district.

**SOCINUS** (Ital. Sozzini). **I. Lælius**, an Italian theologian, born in Siena in 1525, died in Zürich, March 16, 1562. His studies led him to doubt some of the fundamental doctrines of the church, including that of the Trinity. After various travels he resided in Switzerland, Germany, and Poland, finally settling in Zürich. In Wittenberg he gained the friendship of Melanchthon, and in Geneva of Calvin; but the favor of the reformers was withdrawn when his peculiar doctrines were discovered. His life was written in Latin by Illgen (8vo, Leipsic, 1814), who also published in 1826 two parts of another work in quarto, entitled *Symbolæ ad Vitam et Doctrinam Lælii Socini illustrandam.* **II. Faustus**, nephew of the preceding, born in Siena in December, 1539, died near Cracow, March 3, 1604. By his skeptical spirit he had early made himself obnoxious to the authorities of the church, and at the age of 20 was compelled to seek safety abroad. After the death of his uncle, whose property and manuscripts he inherited, he returned to Italy. After spending 12 years as an attendant upon the luxurious court of Florence, he resolved to be a religious reformer, and in 1574 took up his residence at Basel, where he busied himself in elaborating into a system the scattered hints and views in the writings of Lælius. In 1577 he appeared in open debate, maintaining that the Trinity was a pagan doctrine, and that Christ was a created and inferior being. This made him unpopular with the Swiss church, but gave him fame abroad. He was called to Transylvania to oppose Davidis, who had taken the extreme ground that all adoration of Christ was idolatrous. His efforts being unsuccessful, he passed into Poland, where the Anti-Trinitarian party had gained a strong foothold. But his moderate opinions made him unpopular here, and he was coldly received. After four years of residence in Cracow, his marriage with the daughter of a nobleman in the neighborhood gave him new influence. He found a comfortable home, and made proselytes from the noble and wealthy classes. But his wife and her father died, illness prostrated him, his lands in Italy were confiscated, and a few years before his death he was assailed by a mob, dragged into the street, and exposed in the market place; his furniture was broken and his manuscripts were destroyed. His works, contained in the

first two volumes of the *Bibliotheca Fratrum Polonorum*, consist of theological tracts, expositions of Scripture, and polemical treatises, with a great number of letters. Many of his unpublished letters are in the library of Siena. —Though Socinus was the founder of a school in theology, his influence was rather negative than positive. He denied the Trinity, the deity of Christ, the personality of the devil, the native and total depravity of man, the vicarious atonement, and the eternity of punishment. His theory was that Christ was a man divinely commissioned, who had no existence before he was conceived by the Virgin Mary; that human sin was the imitation of Adam's sin, and that human salvation was the imitation and adoption of Christ's virtue; that the Bible was to be interpreted by human reason, and that its metaphors were not to be taken literally. The name Socinian, which is often given to those who hold Unitarian opinions as a term of reproach, was for a century the honorable designation of a powerful and numerous religious body in Poland, Hungary, and Transylvania. It was only the union of the secular and ecclesiastical force during the reigns of Sigismund III. and his successor that succeeded in breaking up and dispersing the Socinian party in Poland; and the Racovian catechism (so called from its place of publication, Raków in Poland), compiled mainly from the writings of Socinus, is still the text book of faith and worship in many Hungarian and Transylvanian churches. The opinions of Socinus are professed still by many churches in Holland, Switzerland, Great Britain, and the United States. His life was written by the Pole Przypcovius, and by the Rev. Joshua Toulmin (8vo, London, 1777).

**SOCIOLOGY**, the science which treats of the actions of men living together in society, and of the institutions thus created. Its scope embraces the whole history of man from the origin of language to the latest development of modern civilization. As a constructive science it is of very recent birth. In a looser sense, as consisting of general speculations upon social affairs, it is almost as old as society itself. Plato, doubtless founding on legendary ideas about the relation between the microcosm and the macrocosm, discovered the parallelism between the parts of a society and the faculties of the human mind; he also philosophically explained the rise of division of labor in a society. Aristotle classified politics, constructed a framework for speculations on government, and stated two of the three sources of the origin of society: instinctive gregariousness and experience of utility. The later Greek historians of Rome indulged in some arbitrary theories about the influence of climate. Hobbes, following the lead of Plato, tried to establish an erroneous parallelism between a society and the human body; but his conception of the state, the Leviathan, as an organism, a living whole made up of related parts, was a real sociological advance. Pascal developed this idea; he regarded the whole succession of human beings as a single individual man, whose youth is the world's antiquity, whose years are the world's generations, whose maturity is the world's prime; he thus formally enunciated the idea of progress, so vital to sociology. Vico held that it might be shown that peoples the most widely separated in place and time had followed nearly the same course in the development of their languages and political condition. About the middle of the 18th century, the French economic sect of the physiocrats maintained that there are natural laws of society which give it a direction of its own, irrespective of legislative interference. Turgot even earlier had discovered that all epochs of history are fastened together by a sequence of causes and effects, and had concluded that there is an ordered movement of advance in societies. Herder, in his *Ideen zur Philosophie der Geschichte der Menschheit* (1784), considers humanity as an individual tending through many vicissitudes to perfection, which it reaches in another world. Of the many socialist schemes which sprang up after the French revolution, that of Saint-Simon alone has any scientific value; and all that was true in his somewhat unscientific speculations has been incorporated by Saint-Simon's secretary and disciple Auguste Comte in his positive philosophy. Comte first subjected the whole course of history to a careful analysis, so as to throw new light on the development of society. He first fully apprehended the relations of biology or the science of man to sociology; first clearly stated the diminishing influence of physical surroundings on societies; first gave its entire weight to the increasing influence of social circumstances, both on the society in which we live and on that which has gone before us. Comte was consequently the first to lay down the lines, although they are rude and imperfect, on which a scheme of society as it will be may be constructed. His sociology, however, bears the marks of the incomplete erudition and backward science of the time. When, in the hands of the Thierrys, Guizot, Villemain, and many others, history had taken a new departure, Comte profited by the movement. But the studies of these distinguished writers were too closely confined to the political and intellectual aspects of society, and Comte followed them in their exclusiveness. Coming in the wake of the great modern scientific movement, Herbert Spencer has attempted to change the face of sociology. Taking up the analogy between society and man, erroneously treated by Plato and Hobbes, Pascal and Turgot, Spencer has converted it into a series of generalizations exhibiting a correspondence between individual organisms and societies, and of these he has made the basis of his new science. He describes each community as a social organism, which has structures and func-

tions. The structures are forms of government, civil, ecclesiastical, military, industrial, and ceremonial; the functions are sentiments, ideas, industrial processes, the fine arts; and both closely resemble the structures and functions of an individual organism. In his "First Principles" he goes further, and seeks to derive social and organic together with inorganic laws from certain ultimate principles. Thus the origin of division of labor in a community, and differences in industrial occupations, are clearly due to diversities of external circumstances. This is an induction; as a matter of fact all simple societies, various groups of which are exposed to unlike outward conditions, tend to become complex societies. Spencer's *a priori* explanation is that, all influence being force, river banks, sea shores, all climatic and local conditions, are forces. If they do not influence the feelings and thus modify the habits of organic beings near them, they are wasted; but this is inconceivable, for force persists. The instability of homogeneous or low forms of social life is therefore deducible from the persistence of force. Passing from general to special aspects of sociology, his plan embraces next the history of the domestic relations. Political organizations as historically based on the family will then be elucidated, and the functions of government discriminated. The necessary development of industry from slavery through serfdom to coöperation will be shown. Intellectual, æsthetic, and moral progress will be regarded as psychological processes determined by social conditions. And finally all phases of society will be shown to be connected with and reacting on one another. But one division of this immense work has been executed (1876).

**SOCORRO,** a S. W. county of New Mexico, bordering on Arizona, intersected in the east by the Rio Grande, and containing the sources of the Gila river; area, about 11,500 sq. m.; pop. in 1870, 6,603. There are fertile valleys along the streams, but the greater part of the county is mountainous and unproductive. Gold, iron, and other minerals are found. The chief productions in 1870 were 26,889 bushels of wheat, 26,860 of Indian corn, 24,006 lbs. of wool, and 2,150 gallons of wine. There were 271 horses, 1,313 milch cows, 1,628 working oxen, 1,514 other cattle, 23,500 sheep, 547 swine, and 4 flour mills. Capital, Socorro.

**SOCOTRA,** an island in the Indian ocean, belonging to the sultan of Oman, about 130 m. E. N. E. of Cape Guardafui, the eastern extremity of Africa; length about 75 m., breadth about 25 m.; area, 1,309 sq. m.; pop. about 3,000. Tamarida, the capital, is in lat. 12° 39′ N., lon. 54° 1′ E. The surface is generally about 800 ft. above the sea, and the shores are bold. Toward the north there is a ridge of mountains with several peaks rising to the height of 5,000 ft. There are some small streams, and where there is sufficient moisture vegetation is remarkably luxuriant. Date trees and cotton are cultivated; but Socotra is particularly famous for aloes and the gum of the dragon's blood tree, both of which are said to be the finest in the world. Camels, horned cattle, sheep, asses, and goats are reared. There is some trade with Muscat.—Christianity appears to have been planted on this island during the apostolic age, and it remained Christian until the end of the 15th century, sharing the fate of the Nestorian church, which the Socotrans had joined. The Portuguese several times attempted to occupy the island and to revive Christianity. In 1834 the English explored Socotra and appeared disposed to occupy it; but they abandoned the design when they occupied Aden. There are two peculiar tribes on the island, one said to be descendants of Jews, and the other of the Portuguese.

**SOCRATES,** a Greek philosopher, born in the immediate neighborhood of Athens between 471 and 469 B. C., died in that city in 399. He was the son of Sophroniscus, a sculptor, and of Phænarete, a midwife, and was trained in his father's art. Tradition ascribed to his chisel three draped figures of the Graces which in the time of Pausanias were shown at the entrance to the acropolis. As a philosopher he called himself self-taught, and referred his knowledge sometimes to books, but more frequently to intercourse with distinguished men. Though traditionally represented as an old, bald-headed man, it is probable that his extraordinary peculiarities were early manifested, and it is certain that he was famous both among wits and the populace in 423, when the "Clouds" of Aristophanes was first exhibited. Plato, Xenophon, and Aristophanes offer different phases and estimates of his philosophy, but agree in the outline of his personal qualities and habits. With remarkable physical strength and endurance, he trained himself to coarse fare, scanty clothing, bare feet, and indifference to heat or cold, aiming thus to reduce the number of his wants, as a distant approach to the perfection of the gods. He had a flat nose, thick lips, prominent eyes, bald pate, squat figure, and ungainly gait, and wandered about the streets of Athens, standing motionless for hours in meditation, and charming all classes and ages by his conversation; so that Alcibiades (in Plato's *Symposium*) likened him to an uncouthly sculptured Silenus containing within the images of the gods, and declared that "as he talks, the hearts of all who hear leap up and their tears are poured out." Though a sage and a martyr, he was wholly removed from asceticism, exemplified the finest Athenian social culture, was a witty as well as serious disputant, and on festive occasions would drink more wine than any other guest without being overcome. Few events of his life are recorded. Of his wife Xanthippe, all that has passed into history is that she bore him three sons, that she had a violent temper, and that he said he married and endured her for self-discipline. He was an enthusiastic lover of

the city, within which alone he found instruction, and beyond the walls of which he never went, except once to a public festival, and again to serve as hoplite at Potidæa (about 431), on the outbreak of the Peloponnesian struggle, at Delium (424), and at Amphipolis (422). At Potidæa he went barefoot over ice and snow, surpassed all other soldiers first in the cheerful endurance of hunger and then in the apparent enjoyment of plenty, and saved the life of Alcibiades, to whom, instead of himself, his own request caused the prize of valor to be awarded. His composure and bravery were alike distinguished at Delium and Amphipolis. He sought influence neither as a soldier nor statesman, and once only discharged a political office. In 406 he was one of the five prytanes of the senate, when the illegal sentence of death was proposed against the victors at the Arginusæ; and he, being epistates for that day, refused to put the question to vote, despite the menaces of the people and the assembly. With four other citizens he was summoned by the thirty tyrants to go to Salamis and bring back Leon to punishment; and he alone refused. Engaged as a missionary in the service of truth and virtue, he was warned from participating in public affairs by what he called a *δαιμόνιον*, *i. e.*, an internal voice, which he professed to hear from childhood in the way of restraint, but never in the way of instigation, and which he was accustomed to speak of familiarly and to obey implicitly. This demon or genius of Socrates, which was not personified by himself, was regarded by Plutarch as an intermediate being between gods and men, by the fathers of the church as an evil spirit, by Le Clerc as one of the fallen angels, by Ficino and Dacier as a good angel, and by later writers as a personification of conscience, or practical instinct, or individual tact. Nor was this the only way in which he thought he received the special mandates of the gods. By divinations, dreams, and oracular intimations, he believed his peculiar mission to be imposed upon him; and when the Pythian priestess pronounced him to be the wisest of men, he was perplexed between the decision of an authority which he deemed worthy of all respect and his own estimate that he had no wisdom whatsoever on any subject. With this sanction, he struck out the original path of an indiscriminate public talker for the sake of instruction. His disinterestedness, poverty, temperance, easy affability, and unrivalled sagacity, as well as his plausible and captivating voice and manner, commended his conversation. He spent the whole day in public, in the walks, the gymnasia, the schools, the porticoes, the workshops, and the market place at the hour when it was most crowded, talking with every one without distinction of age, sex, rank, or condition, discussing with politicians, sophists, military men, artists, and ambitious youths, eager to get self-knowledge and to awaken the moral consciousness, striving to win now Alcibiades and now Theodota to virtue, never accepting money in return for wisdom, attracting listeners during his later years even from the remoter cities of Greece, but founding no school, teaching in no fixed place, and writing no books. His custom was by systematic cross examination to convict every distinguished man whom he met of ignorance. Thus, after hearing the oracular eulogy from Delphi, as reported by Plato in his "Apology," he set out to examine the men whom he deemed wiser than himself. The politicians, the poets, and the artificers were in turn affronted as he attempted to demonstrate their conceit of knowledge without its reality, their skill without wisdom. His irony, or assumption of the character of an ignorant learner, till he involved his opponent in contradictory answers, added zest to his discussions. But he differed from the sophists, though he was ridiculed as the chief of them, in that, whether serious or humorous, he was ever seeking a positive basis for truth, while they for the most part denied the possibility of truth, and could ply the sophistical art with entire indifference to it. In his conception, virtue was as intellectual as vice, and he let slip no opportunity to engage with the masters of sophistry, to follow them through their subtleties, to unravel their captious inquiries, and to wield the weapons of rhetorical adroitness in the interest of truth. He exhibited undisguised contempt for the rulers, proclaiming that government was a most difficult science, and that men, who would not trust themselves in a ship without an experienced pilot, not only trusted themselves in a state with untried rulers, but even sought to become rulers themselves. He thus naturally and necessarily made for himself enemies in every direction and among all classes. Attached to none of the political parties, ridiculed in turn as a buffoon and as a moral corrupter, at once satirized by Aristophanes and hated by the thirty, especially odious from his intimate connection with Critias and Alcibiades, only a decent pretext was wanted to bring upon him the vengeance of power, and this was found in a charge of impiety. An orator named Lycon and a poet named Meletus united with the demagogue Anytus in impeaching him for despising the tutelary national gods, for introducing other and new deities, and also for corrupting the youth. The details of the accusers were, that he worshipped a demon unknown to the mythology, that he contemned the existing political constitution by ridiculing the practice of choosing archons by lot, that he taught young men the habit of depreciating the entire mode of life of their fathers, and that he quoted and perverted passages from the poems of Homer and Hesiod to favor aristocratic doctrines. He approached his trial with no expectation of acquittal, though he had always obeyed the laws, and even in religious opinions was identified with the public mind of Athens.

He commented upon all the imputations, and denied some. He mentioned his blameless life, his divine commission, and the consequent antipathies which he aroused, refuted the charge of irreligion, maintained a calm, brave, and almost haughty bearing, and declared his solicitude rather for the good repute of the Athenians than for himself. He heard without surprise the sentence of condemnation, which was passed by a majority of only five or six in the Athenian dicastery of 567 members. It is probable that the prosecution was designed rather to humble than to destroy him. Xenophon affirms that the defiant and fearless tone of his defence was the direct cause of his condemnation; and it is certain that the capital sentence which followed it was the consequence of his *libera contumacia*, as Cicero expresses it. The penalty of death having been pronounced, he declared himself satisfied both with his own conduct and with the result, calculated that his bearing on the trial would be the most emphatic lesson which he could read to the youth of Athens, and predicted that his removal would be the signal for numerous successors in so worthy a work. An interval of 30 days was allowed for the annual Theoric mission of the sacred ship to Delos, which he passed in prison, with chains on his legs, in conversation with his friends. The Platonic dialogues of "Crito" and "Phædo," in addition to their historic value, may be regarded as imitations or developments of his last arguments on the duty of obedience to the laws and on the evidences of immortality. There is no authority but that of late and untrustworthy writers for the statement that the Athenians lamented his fate and punished his accusers.—The *Memorabilia* of Xenophon and the dialogues of Plato have been supposed to represent an exoteric and an esoteric Socrates, and there has been a long controversy as to which contains the most complete and true history. The former professes to record actual conversations held by him, and was designed as an apology; while the Socrates of the latter is the spokesman of theories which may or may not have been the opinions of the master as well as the disciple. But the two pictures thus presented are in the main accordant. Socrates marks the epoch in Greek philosophy when speculation turned from physics to ethics. He directed his attention to human relations and duties. Astronomy he pronounced a divine mystery; geometry he valued only for land-measuring; general physics he discarded altogether as having furnished and promising nothing but hypothetical, contrary, and useless results; human practice alone, with the knowledge pertaining to it, was esteemed the proper subject of human investigation. According to Cicero, "Socrates called philosophy down from the heavens to earth, and introduced it into the cities and houses of men, compelling men to inquire concerning life and morals and things good and evil."—The most complete discussions concerning Socrates are in general histories of Greece and of philosophy. See also Moses Mendelssohn's life of Socrates, prefixed to his own *Phædon;* Nares, "An Essay on the Demon or Divination of Socrates" (1782); Wiggers, *Sokrates als Mensch, Bürger und Philosoph* (1811); Schleiermacher, *Ueber den Werth des Sokrates als Philosophen* (1815–'18); Lelut, *Du démon de Socrate* (1836); K. F. Hermann, *De Socratis Accusatoribus* (1854); and Zeller, "Socrates and Socratic Schools" (1868). Ueberweg's "History of Philosophy" (1872), vol. i., pp. 80–88, contains a full list of works.

**SODA,** a name given to sodic monoxide, or common oxide of sodium, $Na_2O$, the base of the important series of sodium salts; also to the hydrated oxide, or caustic soda, $NaHO$, and in commerce to the normal carbonate, $Na_2CO_3+10H_2O$. Anhydrous sodic monoxide, or the soda of the chemist, $Na_2O$, is formed when the metal is burned in dry air or oxygen gas, by exposing the dioxide to a high heat, or by heating sodic hydrate with an equivalent quantity of metallic sodium, whereby $NaHO+Na$ is converted into $Na_2O+H$. When sodium is burned in oxygen gas till its weight is constant a dioxide, $Na_2O_2$, is formed. When exposed to the air it deliquesces, and, uniting with carbon dioxide, resolidifies as carbonate. When a heap of it is moistened it becomes heated and evolves oxygen gas. The monoxide attracts moisture as powerfully as the corresponding potassic oxide, forming sodic hydrate or caustic soda, from which the water cannot be expelled by heat alone. The properties of caustic soda resemble those of caustic potash, and it may be prepared from the carbonate by a similar method (see POTASH, vol. xiii., p. 756); but its action upon acids is rather less energetic. Its specific gravity is 2·13. It is manufactured on a large scale in the alkali works according to a process proposed by Mr. Gossage, by which advantage is taken of the presence of caustic soda in the black ash solution. The crude solution of black ash vats is evaporated to a specific gravity of 1·5 or 1·6, during which operation most of the carbonate, sulphate, and chloride crystallize out. The "red liquor," as it is technically called, which owes its color to a compound of sulphide of sodium and sulphide of iron, and which is also contaminated with ferrocyanide and sometimes with sulphocyanide of potassium, has air forced through it while hot, which causes the precipitation of the iron as sesquioxide and the conversion of the sulphur compounds into sulphates. The addition of sodic nitrate completes the oxidation, and this salt may be used for the whole process. After its addition the evaporation is carried further until the whole mass is heated nearly to redness. When the temperature rises to 311° large quantities of ammonia are evolved, and as it increases nitrogen escapes abundantly. The fused soda is poured into sheet-iron vessels, in which it so-

lidifies.—The normal carbonate, existing in certain lakes in Egypt and Hungary, and in the volcanic springs of Iceland and North America, often containing sesquicarbonate, was long known in commerce as *natron*. Large quantities of it and of other soda salts occur in the form of an efflorescence on the "alkali plains" of the western territories. It was formerly prepared artificially from kelp, or the ashes of seaweeds and fuci, and also from barilla, the semifused ash of the *salsola soda*, a plant which has been cultivated with great care by the Spaniards, especially in the vicinity of Alicante, the seed being sown in light low soils which are irrigated by sea water. Barilla yields much more soda than kelp, the latter being now principally used for obtaining iodine. But the quantity of soda obtained from barilla is small in comparison with that manufactured by the process of Leblanc, which consists in first converting chloride of sodium or common salt into sulphate of sodium or Glauber's salt, and then converting the sulphate into carbonate by heating it with carbonate of lime and coal. The conversion of common salt into sulphate or "salt cake" is called the "salt-cake process," and is effected in a salt-cake furnace. One of the best forms of furnace contains two iron vessels or retorts placed in separate heating apartments or furnaces, but connected with each other by a neck. Into the first vessel, called the decomposer, which is oval, are introduced 5 or 6 cwt. of common salt and a rather less weight of sulphuric acid of sp. gr. 1·78, and a gentle heat is applied. Hydrochloric acid is evolved and passes off by a flue to condensing towers containing fragments of coke or stone, through which water is allowed to trickle. There are two towers, the first one receiving the vapors at the bottom, passing what are not absorbed to the top of the other, from the bottom of which the residue, mostly air and some impurities, issues and passes into a large chimney. In the first vessel about half the salt is decomposed, when the pasty mass, consisting of acid sulphate of sodium and undecomposed salt, is thrust into the second vessel or roaster, which is heated to a higher degree, and the decomposition completed. The reaction in the first vessel is as follows: $2NaCl + H_2SO_4 = NaCl + NaH,SO_4 + HCl$. In the second vessel the acid sodic sulphate reacts upon the unchanged salt, the hydrogen taking the chlorine to form hydrochloric acid, leaving two molecules of sodium to unite with the sulphion, $SO_4$; thus, $NaCl + NaHSO_4 = HCl + Na_2SO_4$. The hydrochloric acid gas from both vessels passes through the same flue and condensing towers. The neutral sulphate or "salt cake" is then removed from the second chamber, reduced to powder, and mixed with powdered chalk and coal, in the proportion of two parts each of sulphate and chalk and one part of coal. This mixture is then thrown in quantities of from 2 to 3 cwt. into a reverberatory furnace, and melted while being stirred. The mass is then raked out into a mould from which it is turned when cold, forming ball soda, or black ash, which contains from 20 to 27 per cent. of pure soda or neutral carbonate, minus its water of crystallization, and mixed with calcium sulphate, quicklime, and unburned coal. The reaction is represented as follows: $Na_2SO_4 + CaCO_3 + 4C = Na_2CO_3 + CaS + 4CO$, the chemical changes consisting firstly in the deoxidation of the salt cake, and its conversion into disodic sulphide with evolution of carbonic oxide, and secondly in the formation of sodic carbonate and calcic sulphide by interchange of the constituents of the disodic sulphide and calcic carbonate. The sodium salts are extracted in a series of vats, by warm water which passes from one to the other. Calcium sulphide, which is formed in large quantities, was formerly a waste product, but is now partly utilized in the preparation of hyposulphite of soda, which has been employed to a considerable extent as an "antichlor" for removing the last traces of chlorine from bleached paper pulp. The black solution obtained by the lixiviation of the black ash is allowed to settle, when it is pumped into iron pans and evaporated by the waste heat from the furnaces. Much of the salt crystallizes during ebullition and is removed by perforated ladles. The mother liquor retains a portion of caustic soda, which may be converted into carbonate by mixing it with sawdust and roasting in a reverberatory furnace. At present, however, this conversion into carbonate is not much practised, but the caustic soda is extracted according to the plan of Mr. Gossage, already described. The crude carbonate is crystallized by redissolving it in hot water, allowing this to become clear by standing, and then running it into deep pans, having a capacity to yield about one ton of crystallized carbonate. The solution cools in five or six days, and large crystals are formed. The mother liquor yields an inferior ash.—Sodic carbonate, or commercial neutral carbonate of soda, has a nauseous alkaline taste, and crystallizes in large transparent rhomboidal prisms, containing 10 molecules of water, which melt in their water of crystallization, are soluble in any proportion of hot water, and are also very soluble in cold water. The salt easily parts with its water, and melts at a red heat. If it is crystallized at a temperature of $-4°$ F., 15 molecules of water of crystallization are taken up. Mitscherlich obtained sodic carbonate with six molecules of water of crystallization. Above 93·2° the salt crystallizes in forms derived from the square-based octahedron, containing five molecules of water; but between 158° and 176° it crystallizes in four-sided prisms containing only one molecule of water. The maximum solubility of soda in water is at 100·4°.—The principal uses of commercial carbonate of soda are in the preparation of the bicarbonate and of caustic soda; in the manufacture of hard

soap, for which purpose it is better adapted than potash on account of not being deliquescent like the latter alkali (see SOAP); and also very largely in the preparation of paper pulp from various materials. The paper maker uses it in connection with quicklime, which reduces it to caustic soda. (See PAPER.) It is also used in the laundry, and for domestic and cleansing purposes generally.

**SODA POWDERS.** See EFFERVESCENCE.

**SODA WATER.** See MINERAL WATERS.

**SÖDERMANLAND,** a S. E. læn or province of Sweden, bounded N. by Lake Mælar, E. by the læn of Stockholm, which embraces a portion of the old province of Södermanland, and S. E. by the Baltic; area, 2,603 sq. m.; pop. in 1874, 138,696. It is generally level and fertile, and abounds in inland lakes, including part of Lake Hjelmar. Agriculture is the principal occupation, and the fisheries and lumber trade are of some importance. Capital, Nyköping.

**SODIUM,** the most abundant of the alkali metals, its chloride composing the principal part of the saline matter of the ocean, and also existing in extensive beds in geological strata. Large quantities of nitrate and carbonate of sodium are found in beds, and in some rocks it is combined with silica. The metal was obtained by Sir Humphry Davy soon after his discovery of potassium, and by a similar method. Gay-Lussac and Thénard afterward prepared it by decomposing sodic hydrate with metallic iron at a white heat. It may be prepared readily by the process of Brunner, which consists in distilling a mixture of the carbonate with powdered charcoal. The process has been improved by Deville and others, and employed on a large scale in manufacturing. The carbonate of soda used in the process is prepared by calcining the crystallized neutral carbonate. It is thoroughly dried, pounded, and mixed with a slight excess of charcoal. Ground chalk is also added, to preserve a pasty condition and prevent the carbonate of soda from separating from the charcoal. The following proportions are recommended by Deville for manufacturing operations: dry carbonate of soda, 30 kilogrammes; charcoal, 13; chalk, 3. The materials should be thoroughly mixed, and it is well to calcine the mixture before putting it into the distilling apparatus, by which it is made more compact, so that a greater quantity can be introduced. It is put into cylindrical iron retorts covered with clay, which are heated in a reverberatory furnace. The retorts have movable ends, so that at the close of the operation the charge may be withdrawn and a fresh one introduced without removing the cylinders or putting out the fire. The receivers are of the form used in the preparation of potassium. (See POTASSIUM, vol. xiii., p. 758.) The same precautions are necessary as in the preparation of that metal. The chalk is employed to prevent the charcoal from separating the carbonate of soda when it fuses. The charcoal combines with oxygen when the heat is sufficient to weaken the affinities between the constituents of the salt, and the metallic sodium is left free, when it distils over and is condensed in the receiver, nearly pure if the operation is well conducted. It is perfectly purified by melting it under naphtha, when it may be run into moulds like those used for lead.—Sodium is a brilliant silver-white metal, resembling potassium in its physical and in most of its chemical properties. It is a good conductor of heat and electricity. Its specific gravity is 0·972, its atomic weight 23, and its symbol Na (*natrium*). It is soft at common temperatures, fuses at 207·7° F., and oxidizes rapidly in the air. At the freezing point of water it is very ductile, and at the zero of Fahrenheit it is quite hard. If a small quantity of the metal is melted in a sealed tube filled with coal gas, and cooled till crystallization begins, when the liquid portion is turned off shining octahedral crystals will remain. When dropped into cold water it decomposes it with violence, evolving hydrogen gas, but does not produce enough heat to inflame it unless the metal is held in one spot so that the heat shall not be dissipated. If the water is previously warmed, the gas will take fire, burning with a bright characteristic yellow flame. Sodium is widely diffused in the mineral, animal, and vegetable kingdoms, united with silicic and carbonic acid in many minerals, forms a large share of the saline portions of animal fluids, and enters largely into the composition of marine plants. It unites with oxygen to form two well known oxides: the monoxide, $Na_2O$, the soda of the chemists, and the dioxide, $Na_2O_2$. These two oxides are formed when sodium is burned in common air. When burned in oxygen gas till it no longer increases in weight, it is wholly converted into the dioxide. With water it forms a hydrate, NaHO, which corresponds in composition to the monoxide, a molecule of hydrogen replacing one of sodium. This hydrate is the caustic soda of commerce. (See SODA.)—*Salts.* The salts of sodium are among the most important of all compounds, not excepting those of potassium. The principal one is the chloride, or common salt. (See SALT.) The iodide, NaI, and the bromide, NaBr, are analogous to the corresponding potassium compounds. At temperatures above 86° the bromide crystallizes in anhydrous cubes, but at lower temperatures it unites with two molecules of water and forms hexagonal tables. The iodide, at temperatures above 104°, crystallizes in anhydrous cubes; but at ordinary temperatures large, transparent, striated, oblique rhombic prisms are formed, containing two molecules of water. The small proportion of sodic iodide which is contained in sea water furnishes the commercial supply of iodine, the kelp from which iodine is obtained being the ashes of marine plants which assimilate the iodide from the sea water. (See IODINE.) The sulphides of sodium correspond to those of potassium, and

may be prepared by similar processes. The fluoride, NaF, exists in combination with aluminic fluoride in the mineral cryolite 6(NaF), $Al_2F_6$, found in Greenland and the Ural, which is the chief source of metallic aluminum. (See ALUMINUM, and CRYOLITE.)—Sodic sulphate, the well known Glauber's salt, is described under that title. Sodium unites with sulphurous acid to form a neutral and an acid sulphite. The neutral salt, $Na_2SO_3+10H_2O$, is procured by passing sulphurous anhydride (see SULPHUR), the product of sulphur burned in air, over moistened crystals of sodic carbonate as long as the gas is absorbed, dissolving the mass in water and crystallizing. It is extensively employed for the preparation of the hyposulphite of soda, which is largely used under the name of "antichlor" to remove the last traces of chlorine from bleached paper pulp. (See PAPER, vol. xiii., p. 46.) The acid sulphite, $NaHSO_3$, is of little importance. The hyposulphite, $Na_2S_2O_3+5H_2O$, was formerly made to some extent from impure sodic sulphide, or sulphuret of sodium, by passing sulphurous anhydride through it until it ceased to be absorbed; but it is now largely prepared from neutral sulphite of soda by digesting this salt with sulphuric acid for several days, at a moderate heat. It may also be prepared by digesting a solution of the sulphite with flowers of sulphur. The sulphur is gradually dissolved, forming a clear solution which yields crystals on evaporation; these are oblique prisms belonging to the right prismatic system, freely soluble in water, but insoluble in alcohol. Hyposulphite of soda possesses the property of forming double salts with silver compounds, and in photography it is employed in dissolving away ordinary insoluble compounds of silver, such as chloride and iodide. A mixed solution of sulphite and hyposulphite of soda dissolves malachite and blue copper ore, and Stromeyer has employed it in the hydro-metallurgical extraction of copper. It is also used for preparing antimonial cinnebar and aniline green. Hyposulphite of soda fuses at comparatively low temperatures in its water of crystallization, and advantage is taken of this property in the sealing of glass tubes containing explosive compounds to be used under water in torpedoes. Mr. M. Carey Lea employs it as a new test for ruthenium. If a salt of this metal is made alkaline with ammonia and boiled with the hyposulphite, it first acquires a rose color, and then a magnificent carmine. Employed in medicine, it appears to have deoxidizing powers, in consequence, it has been suggested, of conversion of hyposulphurous into sulphuric acid. It diminishes urea and increases uric acid in the urine, and also increases the sulphates and causes the appearance of sugar and oxalic acid. It has been used, in accordance with the suggestions of Dr. Polli, in zymotic diseases, or those which are supposed to be caused by ferments in the blood, the development of which it has the power of arresting. It has also been used in cases of yeasty vomiting, on account of its destructive effect on the *sarcenia ventriculi* which infests the stomach in that disease, and as a local application in parasitic affections of the skin and mucous membranes. It may be given in doses of from 10 to 20 grains three times a day, dissolved in water. For external use a dram may be dissolved in an ounce of water.—The nitrate, called also cubic nitre, is described in the article NITRATES.—The neutral carbonate, commonly called soda in commerce, is treated under SODA. Bicarbonate of soda, acid sodic carbonate, or monosodic carbonate, may be formed by saturating a strong solution of the neutral carbonate or sal soda with carbonic acid. It is also manufactured on a large scale by passing a current of carbonic acid gas over crushed and moistened crystals of commercial carbonate, exposed two or three inches in depth in a chamber upon cloths stretched horizontally above one another. The carbonate passes into the sesquicarbonate, and then into the bicarbonate, which may be redissolved and crystallized on evaporation in rectangular four-sided prisms, soluble in 10 parts of water at 50°. If the solution is heated, four molecules of bicarbonate lose one of carbonic acid and are converted into the sesquicarbonate ($4NaHCO_3=2Na_2CO_3, H_2CO_3+H_2CO_3$), which by heating to redness, or by continued boiling, is converted into normal carbonate. Bicarbonate of soda is much used in medicine as an antacid and promoter of mucous secretions and perspiration, and as an ingredient in effervescing powders. (See EFFERVESCENCE.) It is also used in bread making, as was formerly the sesquicarbonate. There are several compounds of sodium with boracic acid, but only one is of any practical importance, the acid borate (biborate of soda, or common borax), which is described in the article BORAX.—Sodium forms with the three varieties of phosphoric acid orthophosphates, metaphosphates, and pyrophosphates. Among the orthophosphates are trisodic phosphate, or subphosphate of sodium, $Na_3PO_4+12H_2O$, prepared from rhombic phosphate by adding caustic soda to its solution; and the hydric disodic phosphate, or rhombic phosphate of sodium, $Na_2HPO_4+12H_2O$, commonly called phosphate of soda, and the salt from which most of the phosphates are obtained. The latter is prepared by adding sodic carbonate to acid calcic phosphate, one of the salts formed in obtaining phosphorus. (See PHOSPHORUS, vol. xiii., pp. 464 and 465.) Tricalcic phosphate is precipitated while the disodic phosphate is held in solution. When decanted and evaporated it forms large, transparent, efflorescent, rhombic prisms, soluble in four parts of cold water, but fusing at 90° F. in their water of crystallization. It has an alkaline reaction, and corrodes flint glass, causing white silicious scales to separate from the surface. When evaporated at temperatures above 90°

it combines with seven molecules of water of crystallization, and does not effloresce. On adding free phosphoric acid to a solution of rhombic phosphate, biphosphate of soda, $NaH_2+PO_4+H_2O$, is formed, which crystallizes in right rhombic prisms having a strongly acid reaction. There are several metaphosphates of sodium, and also double salts of the same constitution in which another metal is one of the basyles. There are several pyrophosphates, embracing also both single and double salts, for a description of which the reader is referred to the larger works on chemistry.—The silicates of sodium are glasses of various degrees of fusibility, and also of solubility in water. (See CONCRETE, GLASS, and GLASS, SOLUBLE.) There are several organic salts of sodium, the principal of which are acetates, citrates, oxalates, tartrates, and valerianates; but they do not possess sufficient general interest to require notice here.—*General Characteristics of Sodium Salts.* There are no good direct tests of sodium salts, because they are nearly all soluble, so that the presence of sodium is often inferred when the absence of every other metal is proved, and yet a saline substance remains which yields yellow, striated, prismatic crystals on addition of chloride of platinum and evaporating the solution, a double salt of sodium and platinum being formed. The detection of this double salt is more certain by microscopic examination with polarized light, which tinges the crystals with various characteristic colors. Before the blowpipe the salts of sodium impart an intense yellow to the outer flame. Spectroscopic examination reveals pure yellow light having the same position in the solar spectrum as the double line D. The chief distinguishing characteristics between sodium and potassium salts are, that the latter impart a violet color to flames, and are generally more insoluble, as shown in the slight solubility of sulphate of potassium and the great solubility of Glauber's salt. Many sodium salts moreover effloresce on exposure to the air, while potassium salts generally deliquesce, a fact markedly shown in the carbonates.

**SODOM,** in Biblical history, one of the five cities of the plain or valley of Siddim, destroyed on account of the wickedness of the inhabitants. (See DEAD SEA.)

**SOEST,** a town of Prussia, in the province of Westphalia, 13 m. N. by E. of Arnsberg; pop. in 1871, 12,404. It has a Catholic cathedral, and among the Protestant churches the restored Weisenkirche is remarkable for its pure Gothic architecture. There are many breweries and several manufactories. The principal trade is in grain. The plain surrounding the town contains 10 villages, and is very fertile. Soest was once a Hanseatic town of great importance, but has never recovered from the effects of the thirty years' war.

**SOFALA. I.** A country on the E. coast of Africa, within the territory of Mozambique, of which it forms the southern half. It extends from about lat. 18° to 24° S., and from the seaboard to the Motapa mountains, having an extreme length of about 400 m. and a breadth of nearly 200 m. Along the coast the land is low and swampy, but it rises toward the interior till it terminates in the Motapa range. The country is watered by several considerable rivers, of which the most important are the Sofala, the Sabia, and the Inhamban or Inhambane. The Portuguese established colonial settlements in Sofala early in the 16th century, and the country is still nominally a dependency of Portugal, although European rule is really limited to the few garrisoned stations near the coast. The chief towns are Sofala and Inhamban; the latter port is 8 m. from the mouth of the river of the same name, in lat. 23° 57′ S., lon. 36° 6′ E., and has a good harbor. The exports are mainly amber, beeswax, and ivory. The natives are negroes, and the slave trade is carried on, but to no considerable extent. Sofala was formerly celebrated for its export of gold dust, and some geographers have supposed it to be the Ophir of the ancients. The coast region is very unhealthful. **II.** A town in the above country, formerly the capital of a native kingdom, at the mouth of the river Sofala, in lat. 20° 3′ S., lon. 34° 39′ E. It has a fort and a church, and consists of a few mud and straw huts, though once a place of considerable trade. A bar at the mouth of the river interferes with the approach of large vessels.

**SOGDIANA,** an ancient country of Asia, S. E. of the sea of Aral (*Oxianus Lacus*). It was separated from Bactria on the southwest by the Oxus, and from Scythia on the north by the Jaxartes, thus embracing a part of modern Bokhara. The Persians conquered it in the time of Cyrus. Alexander invaded it in 329 B. C., and established some colonies. After his death it belonged to Syria, and subsequently fell to the Turkomans.

**SOHAR,** a seaport town of Oman, Arabia, capital of the province of Batina, on the sea of Oman, 125 m. N. W. of Muscat; pop. about 20,000. It is surrounded by a wall, defended by a few guns. The castle, a handsome building with three walls around it, occupies a low hill, from which an open space planted with trees extends to the sea. The market place is large and regular, and contains good shops. Many of the houses are of two and three stories and well built. The roadstead is well protected, and offers good anchorage, but large vessels have to lie some distance off shore. Outside the walls is an open sandy space, but beyond it are gardens with shade trees and running waters. The chief manufactures of the town are arms, stuffs of wool, cotton, and silk, carpets, and coverlets. Sohar once had a large trade, but it has been injured by the prosperity of Muscat, and many of its buildings are now in a semi-ruinous condition.

**SOHL.** See ZÓLYOM.

**SOHN, Karl Ferdinand,** a German painter, born in Berlin, Dec. 10, 1805, died in Cologne, Nov. 25, 1867. He studied at the academy of Berlin and under Schadow, whom he accompanied to Düsseldorf and to Italy. He was professor at the academy of Düsseldorf from 1838 to 1855, and became one of the leaders of the Düsseldorf school. He especially excelled in the rich coloring of female figures, and in idealized portraits of ladies. His works include "Rinaldo and Armida" (1827); "Hylas captured by Nymphs" (1829); "Diana in her Bath" (1833); "The Two Leonoras," after Goethe's Tasso (1834); "Romeo and Juliet" (1836); "The Sisters" (1843); "Vanitas" (1844); "The Lute Player" (1848); "The Four Seasons" (1851); and "Loreley" (1853).—His son PAUL EDUARD RICHARD (born in 1834) excels in genre and portrait painting. His nephew and son-in-law WILHELM (born in 1830) has executed good genre pictures, including "A Delicate Question" (1864), and "The Consultation with a Lawyer" (1866).

**SOIL.** See AGRICULTURAL CHEMISTRY.

**SOISSONS** (anc. *Noviodunum*, and afterward *Augusta Suessionum*), a fortified town of France, in the department of Aisne, on the left bank of the river Aisne, 56 m. N. E. of Paris; pop. in 1872, 10,404. It has a cathedral built in the 12th and 13th centuries, the ruined abbey of St. Jean des Vignes, a castle, and a college. In the environs is the abbey of St. Médard, founded by Clotaire I. in 557, now occupied as an institute for deaf mutes. There are manufactures of fine tapestry, linen, hosiery, cordage, earthenware, and leather.—Soissons was the chief place of the Suessiones in the time of Cæsar, and at the beginning of the 6th century the capital of Clovis, who had there defeated the Roman general Syagrius (486), and it gave name to the kingdom of his fourth son. It has sustained many sieges. On Oct. 16, 1870, it surrendered to the Germans, after three weeks' investment and four days' bombardment. The council which condemned Abélard's doctrines met here in 1122.

**SOKOTO.** See SACKATOO.

**SOLANDER, Daniel Charles,** a Swedish naturalist, born in Norrland, Feb. 28, 1736, died in London, May 16, 1782. He was educated at Upsal under Linnæus, studied medicine, made a tour in Russia, and went to England in 1760, after spending some time in the Canaries. He was employed in preparing a catalogue of the collections in the British museum, and in 1766 published a catalogue of the Brander collection of fossils. In 1768–'71 he accompanied Sir Joseph Banks on Capt. Cook's first voyage round the world. In 1771 he received the degree of D. C. L. from Oxford university. In 1773 he was appointed under librarian to the British museum. He greatly promoted the study of botany in England.

**SOLAN GOOSE.** See GANNET.

**SOLANO,** a N. W. county of California, bounded S. E. by the Sacramento river and S. by Suisun bay: area, 800 sq. m.; pop. in 1870, 16,871, of whom 920 were Chinese. The surface consists mostly of valleys, marsh lands, undulating prairies, and high rounded hills. It is one of the best agricultural counties in the state. There is very little timber. Marble is found, and limestone from which a superior hydraulic cement is obtained. It is traversed by the California Pacific railroad. The chief productions in 1870 were 1,949,418 bushels of wheat, 443,400 of barley, 54,780 gallons of wine, 306,817 lbs. of wool, 119,969 of butter, and 37,469 tons of hay. There were 6,852 horses, 1,046 mules and asses, 4,123 milch cows, 8,815 other cattle, 41,890 sheep, and 17,133 swine; 1 manufactory of cars, 1 of cement, 1 of machinery, 7 of saddlery and harness, 8 of wine, 1 flour mill, 3 tanneries, and 3 breweries. Capital, Fairfield.

**SOLANUM,** the name (of unknown derivation) of a genus of plants which is the type of a large and important order, the *solanaceæ*. Some of the conspicuous species of *solanum* being popularly known as nightshade, the order or family is often called the nightshade family. The solanums are annual or perennial herbs, and in warm climates they include shrubs, and even trees, with alternate leaves; the flowers, sometimes terminal or axillary, are often extra-axillary, appearing upon the stem at some point between the leaves, an unusual position due to a more or less complete union between the flower stalk and the main stem. The calyx and wheel-shaped corolla are mostly five-parted or five-lobed, the five stamens with very short filaments, the large anthers crowded around the style, and opening by a pore at the apex of each cell; the (mostly) two-celled ovary is surmounted by a simple style with an obtuse stigma, and in fruit becomes a two-celled berry containing numerous flattened, somewhat kidney-shaped seeds with a fleshy albumen. The genus *solanum* is extensive; in its latest revision (Dunal, 1852) some 850 well defined species are admitted, and about 100 not sufficiently known are enumerated; they are found in all temperate countries, but in tropical regions, especially those of South America, they are very abundant. The most important species is *solanum tuberosum* (see POTATO), the tubers of which are so generally used as food. The tomato (described under its proper title) was placed here by Linnæus, and though later botanists have given it a separate genus, *lycopersicum*, it can hardly be kept distinct from *solanum*. Under EGG PLANT is described another cultivated species, and under NIGHTSHADE is given a common weed, *S. nigrum*. Several species are cultivated for ornament in gardens and greenhouses, and a few wild species, not elsewhere mentioned, are of importance as weeds.—The beaked solanum (*S. rostratum*), very abundant on the plains west of the Mississippi, is a much-branched annual, 2 to 3 ft. high and abundantly armed with strong yellow spines;

it has yellow flowers, one of the anthers of which is much larger than the others, and, being prolonged into a long curved beak, has given the species its name; the small berry is included in the very spiny calyx. This has been introduced into gardens, and in some places has become a weed; the plant is interesting from the fact that it afforded the Colorado potato beetle its chief food before the introduction of the potato in the far west. (See POTATO BUG.)—One of the worst weeds of cultivation is *S. Carolinense*, known in some localities as horse nettle, and in others as apple of Sodom; it has a perennial root, with prickly stems a foot or more high; the oblong, sinuate leaves prickly on both sides; the bluish white flowers, in small lateral racemes, are succeeded by orange-yellow berries about a third of an inch in diameter. This is especially abundant and troublesome in the southern states, and is sparingly found as far north as Connecticut. It is very hard to extirpate, and in some parts of Delaware it has gained such complete possession of the soil as to lessen materially the value of farms, and in some cases to cause fields to be abandoned.—A climbing species, *S. dulcamara*, is popularly known as bitter-sweet; the rind of the stalks is said to taste at first bitter and afterward sweet, a peculiarity recognized in the Latin name, *dulcis-amara*, given to the plant in the 16th century. It is a native of Europe, is thoroughly naturalized in all the older states, and is not rare in cultivation. The stem is somewhat climbing, and grows to the height of 6 to 10 ft.; it is woody at the base, but the upper part is killed back every winter; the leaves are usually ovate-heart-shaped, but frequently the upper ones have a lobe on each side at the base

Bitter-sweet (Solanum dulcamara).

and become halberd-shaped; the flowers are in small cymes; the corolla is pale blue or purple, against which the large yellow anthers appear in strong contrast, and make them rather showy; they are succeeded by an oval berry about half an inch long, and bright red; the plant begins to bloom in June and continues till autumn, and flowers and fruit in every intermediate stage up to full ripeness may usually be found upon it. Though bitter-sweet has been in use as a medicine for some centuries, there is very little positive knowledge concerning it; it appears to contain a very small amount of solanine in a modified form; it has been used in gout and rheumatism, in various affections of the chest, and in skin diseases. The berries are very showy, and, being not unpleasant to the taste, are liable to be eaten by children; in regard to their effects there is the most opposite testimony; some authors assert that they are highly poisonous, while Garrod says that he has administered to a patient half a pound of the fresh berries daily with no ill effect.—Several species of *solanum* are ornamental plants in the greenhouse and garden; some of these, valued for their ornamental fruit, are described under JERUSALEM CHERRY. The jasmine-like solanum (*S. jasminoides*) is a tall, climbing house plant from Brazil, with dark green, smooth, ovate or heart-shaped leaves, and large clusters of white or slightly bluish and pleasantly fragrant flowers, produced in profusion; it is an admirable greenhouse climber, and is often planted out in summer; in the southern states the root remains alive through the winter. Some of the erect tropical species have a very robust habit of growth and ample foliage; in some the large leaves are handsomely cut; in others they are marked by pleasing contrasts of color, and the flowers are often showy. Among the best are *S. crinitum*, *S. macranthum*, *S. marginatum*, and *S. Warscewiczii*, which grow from 3 to 8 ft. high and are highly ornamental.

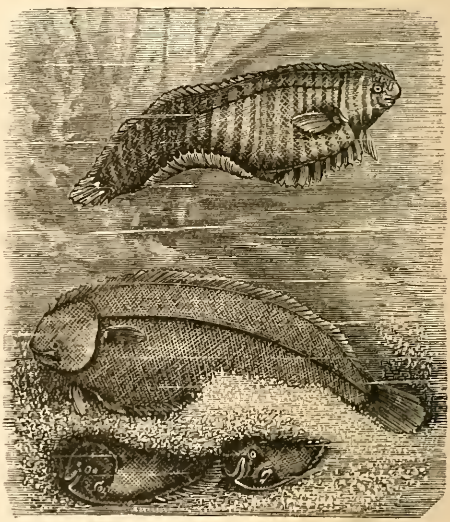
Ornamental-leaved Solanum (S. Warscewiczii).

**SOLAR SYSTEM.** See PLANET, and SUN.

**SOLAR TIME.** See DAY.

**SOLDER** (Lat. *solidus*, solid), a metal or alloy used for joining together different pieces of metal, whether of the same or of different kinds. Solders are divided into hard and soft. The soft solders may be used for joining all kinds of metals, but usually those having low melting points. The hard solders are better adapted for the less fusible metals, especially where strength is required. Practically the solder must be more fusible than either of the metals to be united, but the more nearly these points coincide the stronger will be the union. Gold in the form of leaf or fine shreds is used for soldering platinum vessels; it may be slightly alloyed with copper. Silver is considered the best solder for German silver. Copper in shreds is often used for iron when welding is not permissible, sometimes slightly alloyed with zinc. Soft solders have tin for a basis, generally alloyed with lead. Those containing much lead are sometimes ranked with hard solders. Pewter may be used for a solder, and by the addition of bismuth, antimony, or cadmium its fusing point may be lowered so that it can be used as a solder for pewter. The following are some of the more important solders. For gold: gold (18 carats) 66·6, silver 16·7, copper 16·7. A good gold solder for general purposes is 100 parts of gold, 40 of silver, and 30 of copper (Makins). For silver: silver 66·6, copper 30, brass 3·4; or silver 65, copper 24, zinc 11. It is better to add the metals separately than to use brass, which may have an uncertain composition. Pewterer's solder: coarse—tin 3, lead 4, bismuth 2; fine—tin 2, lead 1, bismuth 1. Plumber's solder: tin 1, lead 3; a finer kind has the same composition as fine pewterer's solder. Hard spelter solder, used for soldering copper, is made of copper 16, zinc 12. Soft spelter solder, for brass, is made of equal parts of copper and zinc. Fluxes are used to preserve the cleanness of the surfaces of the metals and free them from oxide while the operation of soldering is going on. The solder is applied in various ways. The surfaces, sometimes previously cleaned with a file or with muriatic acid or an acid solution of chloride of zinc, are brought together, and the solder in strips or grains laid on. Then a flux composed of borax or sal ammoniac, sometimes mixed with a little common rosin, is applied, and the parts are heated with a blowpipe or a stream of intensely heated air. But it is more common to use a soldering iron, an instrument consisting of a heavy square, pyramidal, or conical piece of copper, riveted in a fork of wrought iron, to which a wooden handle is attached. This "iron," being heated above the fusing point of the solder, is applied to it, and a few adhering drops of the melted alloy are carried to the parts to be joined, which are then held in position until the solder hardens. Aluminum cannot be soldered in the ordinary way, but must first be tinned. A good general solder for aluminum is composed of zinc 90, aluminum 6, copper 4.

**SOLE** (*solea*, Cuv.), a genus of soft-rayed flat fishes of the family *pleuronectidæ*. (See Flounder.) The genus has the jaws concealed under the scaly skin, the upper rounded and longest; the eyes are both on the right side, small, the lower behind the upper and almost at the angle of the mouth; the mouth is curved, and turned almost wholly to the left side, and the fine and villiform teeth are nearly all on this side; the snout is in advance of the mouth; the lateral line straight; branchial openings below the small pectorals; dorsal and anal very long, often confluent with the caudal; no air bladder, and no pancreatic cæca, and the intestine long and often doubled; the blind side is sometimes furnished with shred-like villi. The common sole (*S. vulgaris*, Cuv.) has the body more elongated than in most flat fishes, with a blunt and rounded muzzle; the length is from 10 to 20 in., and the color uniform dark brown above and white below, the pectorals tipped with black. It inhabits the sandy shores of Great Britain, keeping near the bottom, feeding on the spawn and fry of other fishes and on shell fish; it is found from the seas of Scandinavia to the Mediterranean. It is one of the best and most delicate fishes for the table, and is caught in immense numbers by trawl nets; the flesh is white and firm, and is in good condition all the year except in February and March, when they are spawning. Some are found reversed, or with the eyes and colored surface on the left side, and a few are dark and rough on both sides. In the genus *achirus* (Lac.) there are no pectorals; species



Common Sole (Solea vulgaris).

are found in the Indian seas, with the upper parts marbled with brown and lighter. The New York sole (*A. mollis*, Mitch.) is 6 to 8 in. long, dark brown, marked transversely with

irregular black bands, and has small scales; it is found from Nantucket to North Carolina.

**SOLEURE.** See SOLOTHURN.

**SOLFERINO,** a village of Lombardy, in the province and 20 m. S. E. of Brescia. It has a ruined castle, formerly the residence of a prince of Solferino; but it is chiefly remarkable for the great victory won here by the allied French and Sardinian forces over the Austrians on June 24, 1859. The battle lasted 16 hours, and four French corps under Marshals Baraguay d'Hilliers, MacMahon, Canrobert, and Niel, and led by the emperor Napoleon III., and four divisions of the Sardinian army, commanded by Victor Emanuel in person, were opposed to an immense Austrian force, under the command of the emperor Francis Joseph. The allies lost about 18,000 killed and wounded; the Austrians, 20,000, besides 6,000 prisoners and 30 cannon. The battle closed the war, and the peace of Villafranca followed. On June 24, 1870, the bones of the slain on this field were collected in three ossuaries, which were consecrated in the presence of representatives of France, Italy, and Austria.

**SOLGER, Karl Wilhelm Ferdinand,** a German author, born in Schwedt, Prussia, Nov. 28, 1780, died in Berlin, Oct. 20, 1819. After extensive studies and a varied career, he finally became in 1811 professor of philosophy at Berlin. His works include a translation of Sophocles (1808; 2d ed., 1824); *Erwin: vier Gespräche über das Schöne und die Kunst* (2 vols., 1815); *Philosophische Gespräche* (1817); posthumous writings and letters, edited by Tieck and Raumer (2 vols., 1826); and lectures on æsthetics, edited by Heyse (1829).

**SOLIMAN.** See SOLYMAN.

**SOLINGEN,** a town of Rhenish Prussia, near the Wupper, 12 m. S. E. of Düsseldorf; pop. in 1871, 14,040. It contains a Catholic and two Protestant churches, a synagogue, a superior school, and a chamber of commerce. It has for centuries been celebrated for its manufacture of sword blades and other cutlery, and iron and steel ware. There are in and around Solingen more than 2,700 establishments, employing about 10,000 persons.

**SOLIS, Antonio de,** a Spanish historian, born in Alcalá de Henares, July 18, 1610, died in Madrid, April 19, 1686. After becoming celebrated as a dramatist and poet, he was appointed official historiographer, and entered holy orders in 1667. His principal historical work is *Historia de la conquista de México* (fol., Madrid, 1684; new ed., Paris, 1858; English translation by Townsend, 2 vols, London, 1724, reprinted in 1738 and 1753). His most celebrated play, *La Gitanilla*, or "The Pretty Gypsy Girl," is founded on Montalvan's piece borrowed from the story of Cervantes. A collection of his plays appeared at Madrid in 1732.

**SOLIS, Juan Diaz de,** a Spanish navigator, born in the latter half of the 15th century, killed in South America in 1516. In conjunction with Yañez Pinzon, he discovered Yucatan in 1506. In 1508 they unitedly explored the coast of South America from Cape St. Augustine to lat. 40° S., and took possession of the continent for Spain. Having quarrelled, they returned to Spain in 1509; a lawsuit followed, and Solis was beaten and imprisoned, and Pinzon received important grants in the island of San Juan. Afterward Solis was released, was paid 34,000 maravedis indemnity, and on the death of Amerigo Vespucci became pilot major. In 1515, with three ships, he explored the coast from Cape San Roque to Rio de Janeiro, entered the estuary of La Plata, which he called the Mar Dulce, and ascended the river. He was kindly received by the Indians, but afterward ambuscaded, killed, and eaten. According to some authorities, he discovered the Plata in 1512, and made a second voyage to it.

**SOLLY, Samuel,** an English surgeon, born in 1805, died in London, Sept. 24, 1871. He became a member of the London college of surgeons in 1828, lecturer on practical anatomy and assistant surgeon to St. Thomas's hospital in 1833, and subsequently attending surgeon. He was also for many years lecturer on surgery. His principal work is "Anatomy and Pathology of the Brain" (2d ed., 1847), which was for a long time a valuable and standard book. He also published "Surgical Experiences" (1865). He was fellow, member of the council, and for two years vice president of the college of surgeons.

**SOLMIZATION,** in singing, the application to the seven notes of the musical scale of the syllables *ut* (or *do*), *re*, *mi*, *fa*, *sol*, *la*, *si*, to enable the singer to acquire full command of the vowel sounds. (See MUSIC, vol. xii., p. 76.)

**SOLOMON.** See HEBREWS, vol. viii., p. 586.

**SOLOMON, Song of.** See CANTICLES.

**SOLOMON, Wisdom of.** See WISDOM, BOOK OF.

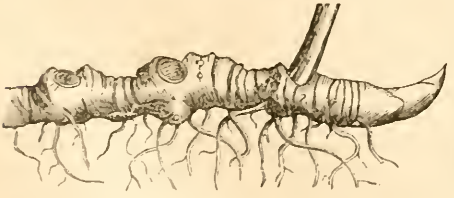
**SOLOMON BEN GABIROL** (properly perhaps Solomon ben Judah ben Gabirol, and popularly Gabirol), a Jewish philosopher and poet, born in Malaga, Spain, about 1020, died in Valencia or Ocaña about 1075. Almost all that is known of his life is that he lived for a time in Saragossa, and was intimate with Samuel Hallevi. As a Hebrew poet he immortalized himself by his *Kether malkhuth* ("Crown of Royalty"), a didactic hymn on the cosmos, which has been incorporated in the Jewish liturgy. His philosophical works he wrote in Arabic, and only incomplete Hebrew translations of them are extant. His "Source of Life," in which he appears as a bold Aristotelian, is cited by Albertus Magnus and other mediæval Christian philosophers, the name of the author appearing in the corrupt forms of Avicebron, Avencebrol, &c., derived from the Arabic Aben Gebrol. The identity of the names has but recently been established.—See Munk, *Mélanges de philosophie juive* (Paris, 1857).

**SOLOMON BEN ISAAC,** rabbi, erroneously surnamed YARHI or JARCHI, and generally known

under the abbreviation Rashi (the initials of the Hebrew *Rabbi Shelomoh Yitz'haki*), a Jewish commentator of the Bible and Talmud, born in Troyes, France, about 1040, died there, July 13, 1105. His comments on the Talmud have never been excelled, and they accompany all editions of the text. Those on the Bible have been translated into Latin by Breithaupt (3 vols., Gotha, 1710–'14). A German translation of the commentary on Genesis was made by Hayman (Bonn, 1833), and one of the whole Pentateuch by Lucas (Prague, 1833–'8).

**SOLOMON ISLANDS**, a group of the S. Pacific lying S. E. of New Britain and E. of New Guinea, extending in a S. E. direction from lat. 4° 50′ to 11° 50′ S., and from lon. 154° 30′ to 162° 30′ E. The group is composed of the islands Bougainville, Choiseul, Malayta, Santa Isabella, New Georgia, Guadalcanar, San Cristoval, and several smaller ones, the area of the whole being estimated at 10,000 sq. m. Mountains, often of considerable height, traverse them. The shores are generally low, and in some places bordered with mangrove swamps. They are watered by numerous streams, and the temperature is cooled by copious rains. They are very fertile; bananas, yams, sugar cane, and ginger are cultivated; and the breadfruit, cacao, and clove trees abound. They are inhabited by negrillos and Malays. The population is very irregularly distributed, the northern islands being more populous than the others.—The islands were discovered and explored in 1568 by the Spanish navigator Mendaña, sent out by his uncle Lope de Castro, viceroy of Peru. He named them Solomon islands on the pretence that the riches of Solomon's temple were brought from them. He died in Santa Cruz group in 1595, while on his way to colonize them, and they were not again visited till rediscovered by Carteret in 1767. Some partially successful missionary efforts have recently been made there.

**SOLOMON'S SEAL**, the common name for species of *polygonatum* (Gr. πολύς, many, and γόνυ, knee, the stems having numerous joints), a genus of the lily family, closely related to asparagus, and having thick, knotted, horizontal rootstocks, which show upon their upper



Solomon's Seal. Rhizome, showing stem, bud, and scars of former stems.

surface deep scars left by the falling away of the stems of previous years, a character which gave rise to the popular name. Each rootstock bears a single leafy stem; in front of it is a bud to continue the growth another year, and behind it are the scars of former stems; the stems, 1 to 4 ft. high, are gracefully curved, and clothed with nearly sessile or half clasping, strongly nerved leaves, from the axils of which appear the drooping greenish flowers; the perianth is cylindrical, six-lobed at the summit, with six stamens inserted near the middle of the tube; the three-celled ovary ripens to a globular black or blue berry with two to six seeds. The great Solomon's seal (*P. giganteum*) and the smaller (*P. biflorum*) are common species, while the remaining one, the broad-leaved (*P. latifolium*), is very local. Several species are found in Europe, which were formerly used medicinally, and ours have a reputed value as diuretics. The young shoots are cooked and eaten in Turkey like asparagus, and the roots, which contain a considerable quantity of starch, have been used in Europe as food in times of scarcity. They are interesting but not showy garden plants. Species of the related genus *smilacina* are called false Solomon's seal; they have their flowers in terminal racemes, and mostly red berries.

**SOLON**, the Athenian lawgiver, born about 638 B. C., died in Athens about 559. He was a lineal descendant of Codrus. In his youth he visited many parts of Greece and Asia as a merchant, gained distinction by his poems, and from his reputation for political wisdom was reckoned one of the seven sages. Returning to Athens, he began his political career by recovering Salamis from the Megarians. The Athenians had repeatedly failed in their attempts upon this island, and had prohibited any citizen on pain of death from proposing a renewal of the enterprise. Solon counterfeited madness, and in apparent frenzy read in the agora a short poem, the effect of which was that the law was rescinded, war was declared, and he himself was appointed to the command of it. In a single campaign (about 600) the Megarians were expelled from the island, but a tedious conflict ensued, which was finally settled in favor of Athens by the arbitration of Sparta. Soon after, in the Amphictyonic council, he moved the decree by which the Athenians espoused the cause of the Delphian oracle against Cirrha. In 594 he was called by all parties to the archonship, with powers substantially dictatorial, and chiefly with authority to confirm, repeal, or modify the Draconian laws. The constitution of Solon (see Athens, vol. ii., p. 55), which made property instead of birth the title of citizenship, and which was the prelude to the subsequent democracy, was by a solemn oath of the government and people declared valid without alteration for ten years. He obtained leave of absence for that period, visited Egypt, and went thence to Cyprus, where he persuaded the prince of Æpea to change the site of the town, and himself made the regulations for the prosperity of the new establishment, which in his honor was called Soli. He returned to

Athens prior to the first usurpation of Pisistratus (560), and amid violent dissensions was respected by all parties, but was unable to overrule the popular favor of his kinsman.—The chief sources for the biography of Solon are the compilations of Plutarch and Diogenes Laërtius. The extant fragments of his verses are usually contained in the collections of the Greek gnomic poets, and there is a separate edition of them by Bach (Leyden, 1825).

**SOLOTHURN** (Fr. *Soleure*), a N. W. canton of Switzerland, bordering on Basel Country, Aargau, and Bern; area, 303 sq. m.; pop. in 1870, 74,713, of whom 62,078 were Roman Catholics. The Jura mountains occupy a part of the canton, and the remainder of the surface is level and fertile. It is traversed by the river Aar, a tributary of the Rhine. Gold, silver, iron, and lignite are found. The soil is remarkably fertile. A great deal of the surface is occupied by meadows and pastures, upon which large numbers of cattle are kept. The forests are extensive, and afford valuable timber. German is the language of the canton. The government was formerly aristocratic, but democratic principles have been largely introduced into it, especially by the revision of the constitution in 1841.—SOLOTHURN, the capital, is at the foot of the Weissenstein, on the Aar, 17 m. N. by E. of Bern; pop. in 1870, 7,054. It has one of the finest cathedrals of Switzerland, an arsenal with a large collection of ancient armor, and a museum containing a rich collection of Jura fossils. Till 1874 it was the seat of the bishop of Basel.

**SOLSTICE** (Lat. *sol*, the sun, and *stare*, to stand), the period in the annual revolution of the earth round the sun when he is at that point in the ecliptic furthest north or south from the equator, or in other words reaches his greatest northern or southern declination. There are two solstices in the year: the summer solstice, June 22, when the sun seems to traverse the tropic of Cancer; and the winter solstice, Dec. 22, when he reaches his greatest southern declination, and appears to traverse the tropic of Capricorn. For several days before and after the solstice there is but a slight variation in the sun's apparent declination, and so far as his motion from and toward the ecliptic is concerned he may be said to stand still. The solstitial points are the two points of the sun's greatest elevation above or depression below the equator; and a circle through these points and the poles of the earth is called the solstitial colure.

**SOLUBLE GLASS.** See GLASS, SOLUBLE.

**SOLWAY FRITH,** an arm of the Irish sea, which extends 40 m. N. E. between England and Scotland, with a breadth varying from 24 m., between St. Bees Head in Cumberland and Rayberry Head in Kirkcudbrightshire, to 2 m. It receives on the English side the rivers Derwent, Ellen, Waver, Wampool, and Eden; and on the Scottish side, the Urr, Nith, and Annan. Whitehaven, Maryport, and Allonby are on the English side, and Annan and Kirkcudbright on the Scottish. At ebb tide the broad sands which occupy a considerable portion of the frith are left dry.

**SOLYMAN II.,** or **Soleiman,** called the MAGNIFICENT, an Ottoman sultan, born about 1495, died before Sziget in Hungary, Sept. 5, 1566. He was the son of Selim I., whom he succeeded in 1520. In 1521 he subdued the rebellion of Ghazali Bey in Syria, and in Hungary took Belgrade and other fortified towns. After an arduous siege he took Rhodes from the knights of St. John in 1522. He invaded Hungary a second time in 1526, won the decisive battle of Mohács (Aug. 29), in which Louis II. of Hungary lost his life, overran a part of the kingdom, and recognized as king John Zápolya, who put himself under Solyman's protection. This embroiled the sultan with Ferdinand I. of Hapsburg, who was elected king by the majority of the Hungarians, and began the first of the Turkish wars against Germany. In 1529 Solyman took Buda, and appeared before Vienna with a vast army; but after a number of assaults he retired with a loss of 80,000 men. A second attempt in 1532 was baffled by the resistance of Güns under Jurisics. In 1534 he invaded Persia, and subdued Armenia and Irak, with the cities of Tabriz and Bagdad; in 1536 formed an alliance with Francis I. of France against Charles V., the brother of Ferdinand; in the same year created the Barbary corsair Khair ed-Din or Barbarossa a Turkish admiral, and thus swept the Mediterranean and Italian coasts; conquered Croatia in 1537 by a great victory over the imperialists at Eszék; and in 1538 made the conquest of Yemen. An attempt in 1537 on Corfu failed. Upon the death of John Zápolya in 1540, he supported his son John Sigismund, and continued the war with Ferdinand till 1547, when a truce humiliating to that prince was agreed upon. He now again invaded Persia, in 1548 gained a victory at Van in Armenia, and in 1549–'50 conquered the provinces of Shirvan and Georgia. Hostilities in Hungary were renewed in 1552. John Sigismund was established in Transylvania under Turkish protection, and Solyman's fleets under Piali, the successor of Khair ed-Din, gained a victory over the combined fleets of the emperor at Jerba on the African coast. A truce made in 1562 left the Turks in possession of their Hungarian conquests. In an attempt upon Malta in 1565, the whole naval force of Solyman was repulsed. In 1566 he again led a vast army to the invasion of Hungary, crossed the Drave, and laid siege to the fortress of Sziget, which was defended by a small garrison under Zrinyi; but a paroxysm of anger at the terrible repulses he encountered induced an attack of apoplexy, in which he died a few days before the last and fatal assault was made. Under this sultan the Ottoman empire attained its greatest military power, and it began immediately to decline under his succes-

sor, Selim II. By the Turks he was surnamed the Legislator (*Kanuni*), and the *Kanun Nameh*, or code of laws and regulations, drawn up under his direction, formed the basis for a long period of the Turkish administration of government and justice. He was also a patron of literature and art; in his reign the use of the Turkish language in literature superseded that of the Persian.

**SOMAULI,** or **Somal,** the general name of the tribes inhabiting that portion of Africa S. of the gulf of Aden, and extending from Cape Guardafui and the straits of Bab-el-Mandeb to the Doho river. The eastern tribes are called Burri, the western Gulbedh. The principal eastern tribes are the Midjertheyn, the Wursumgalli, and Dulbhanta; the principal western, the Habr Awal, the Habr Tul Jaala, and the Habr Gerhajis. The eastern tribes are generally peaceable and orderly, the western savage and warlike. They are all Mohammedans, and are very superstitious, believing in charms and witchcraft. They live generally in houses made of mats. Slavery exists among them. In war they use shields, spears, bows, and poisoned arrows. Their principal articles of trade are various kinds of gums, tragacanth, myrrh, and especially frankincense. They are generally governed by chiefs, who however have little power. The characters and modes of life of the various tribes differ greatly. Their language is a mixture of Arabic and Galla words, and the race is supposed to be of the same mixed origin.

**SOMERS, John,** lord, an English statesman, born in Worcester, March 4, 1651, died April 26, 1716. He was educated at Trinity college, Oxford, and in 1676 was called to the bar at the Middle Temple, but remained some years longer at the university, publishing several political pamphlets, and a variety of metrical and prose versions from classical authors. He began to practise law in London in 1682, acquired great professional eminence, and became a leader of the whig party. He represented Worcester in the convention which met in January, 1689, and was a member of the two committees (acting as chairman of the second) which prepared the "Declaration of Right." In 1689 he was appointed solicitor general and knighted, in 1692 attorney general, in 1693 lord keeper of the great seal, and in 1697 lord chancellor, when he was raised to the peerage as Baron Somers of Evesham. After ineffectual attempts to fasten upon him a charge of maladministration, and also of complicity in the piracies of Capt. Kidd, whom he had helped fit out a ship to capture pirates, an unsuccessful motion was made in the house of commons, April 10, 1700, that the king should be requested to dismiss him. But his absence by illness from the debates upon a measure distasteful to William, assumed to be by design, induced the king on the 17th of the same month to remove him. In the next year an attempt was made to impeach Somers on 14 distinct charges, the most important of which referred to an illegal issue at the king's request of blank commissions under the great seal for the purpose of negotiating certain treaties, to his alleged complicity with Kidd, and to his acquisition of various unreasonable grants from the crown in addition to the salary and fees of his office; but the commons declined to prosecute the impeachment, and he recovered the favor of the king, whose last speech to parliament was written by him. On the accession of the whigs to power in 1708, Somers was appointed president of the council, and held the office until the return of Harley and the tories in 1710. Subsequently he participated in legislative duties until his death, which happened from apoplexy. A number of original letters and papers, illustrating his life and character, perished by fire in 1752. The so-called "Somers Tracts" (16 vols. 4to, 1748–'52; new ed. by Sir Walter Scott, 13 vols. 4to, 1809–'15) consist of pamphlets selected chiefly from his library. R. Cooksey wrote "Life and Character of Lord Somers" (4to, 1791).

**SOMERS ISLANDS.** See Bermudas.

**SOMERSET,** the name of four counties in the United States. **I.** A W. county of Maine, bordering on Canada, intersected by the Kennebec river, and drained by the head streams of the Penobscot and Walloostook rivers; area, 3,800 sq. m.; pop. in 1870, 34,611. The surface is diversified, and the soil generally good. There are several small lakes, and the N. part is covered with forests, affording vast quantities of timber for export. The Maine Central and the Somerset railroads enter it. The chief productions in 1870 were 31,202 bushels of wheat, 106,657 of Indian corn, 296,185 of oats, 92,767 of barley, 20,536 of buckwheat, 31,408 of peas and beans, 988,179 of potatoes, 113,481 tons of hay, 366,442 lbs. of wool, 796,238 of butter, and 169,349 of cheese. There were 7,222 horses, 11,132 milch cows, 5,886 working oxen, 14,954 other cattle, 78,400 sheep, and 3,590 swine; 23 manufactories of carriages and wagons, 2 of edge tools and axes, 5 of furniture, 8 of tanned and 5 of curried leather, 1 of paints, 1 of paper, 6 of sash, doors, and blinds, 6 of turned and carved wood, 3 of woollen goods, 9 wool-carding and cloth-dressing establishments, 5 flour mills, and 39 saw mills. Capital, Skowhegan. **II.** A N. central county of New Jersey, bounded N. E. by the Passaic and W. by the Lamington river, intersected by the Raritan, and traversed by the Delaware and Raritan canal and several railroads; area, 275 sq. m.; pop. in 1870, 25,510. The surface in some parts is very hilly, and the soil generally fertile, especially along the streams. The chief productions in 1870 were 218,766 bushels of wheat, 561,136 of Indian corn, 700,515 of oats, 86,684 of potatoes, 42,034 tons of hay, 22,457 lbs. of wool, 3,800 of flax, and 587,093 of butter. There were 6,263 horses, 9,992 milch cows, 4,922 other cattle, 7,302 sheep, and 7,883 swine;

2 manufactories of agricultural implements, 8 of cheese, 1 of pig iron, 3 of castings, 10 tanneries, 6 distilleries, 18 flour mills, and 7 saw mills. Capital, Somerville. **III.** A S. W. county of Pennsylvania, bordering on Maryland, bounded W. by the Youghiogheny river and Laurel ridge, and intersected in the south by Castleman's river; area, 1,000 sq. m.; pop. in 1870, 28,226. The surface is generally mountainous, and the soil fertile. The glades are admirably adapted to grazing. The county abounds in bituminous coal, and iron ore, fire clay, and cannel coal of excellent quality are found. It is traversed by the Pittsburgh, Washington, and Baltimore railroad. The chief productions in 1870 were 134,641 bushels of wheat, 142,515 of rye, 92,277 of Indian corn, 559,616 of oats, 49,779 of buckwheat, 84,476 of potatoes, 51,327 tons of hay, 80,177 lbs. of wool, 1,344,522 of butter, 11,005 of flax, and 674,326 of maple sugar. There were 8,273 horses, 13,811 milch cows, 15,157 other cattle, 32,343 sheep, and 10,748 swine; 43 tanneries, 16 saw mills, and 14 woollen mills. Capital, Somerset. **IV.** A S. E. county of Maryland, on the E. shore of Chesapeake bay, and bounded S. E. by the Pocomoke river and sound; area, about 400 sq. m.; pop. in 1870, 18,190, of whom 7,274 were colored. The surface is level and the soil generally fertile. It is intersected by the Eastern Shore railroad. The chief productions in 1870 were 40,719 bushels of wheat, 251,883 of Indian corn, 100,110 of oats, 105,009 of Irish and 42,026 of sweet potatoes, and 9,090 lbs. of wool. There were 1,235 horses, 1,693 milch cows, 4,427 other cattle, 3,199 sheep, and 7,628 swine. Capital, Princess Anne.

**SOMERSET, Edward Seymour,** duke of. See Seymour.

**SOMERSET, Robert Carr,** earl of. See Overbury, Sir Thomas.

**SOMERSETSHIRE,** a S. W. county of England, bordering on the counties of Gloucester, Wilts, Dorset, and Devon, and the Bristol channel; area, 1,636 sq. m.; pop. in 1871, 463,412. The coast is indented by several bays, the chief of which is Bridgewater bay. The principal rivers are the Avon, Frome, Yeo, Axe, Brue, and Parret. The Avon, Bridgewater, and other canals, and the Great Western railway intersect the county. The surface is hilly, but there is also a great extent of marshy land, and much of the soil is very fertile. Wheat and potatoes are the principal crops, and large numbers of cattle and sheep are reared. Coal, iron, and lead are largely produced. Woollen cloth, canvas, gloves, silk, lace, paper, glass, and various kinds of iron ware are manufactured. Somersetshire contains many remains of antiquity. Bristol is partly in this county, and the other principal towns are Bath, the capital, Wells, Taunton, Bridgewater, and Frome.

**SOMERSWORTH,** a town of Strafford co., New Hampshire, on the Salmon Falls river, which separates it from Maine, and on the Eastern and Boston and Maine railroads, 33 m. E. of Concord and 65 m. N. of Boston; pop. in 1870, 4,504. It is the fifth town in the state in point of manufactures, the principal village being Great Falls, near the falls of that name in Salmon Falls river. The Great Falls manufacturing company, with a capital of $1,500,000, controls the water power (reckoned at 3,200 horse power), and employs about 1,800 hands, manufacturing about 20,000,000 yards of cotton goods annually. The Great Falls woollen company manufactures cassimeres, and the Somersworth machine company stoves and castings of all kinds; these have a capital of $100,000 each. There are several smaller manufactories, including a flour mill with a capital of $30,000. The village contains three banks, two hotels, about 60 stores, 15 schools, a public library of 6,000 volumes, a weekly newspaper, and six churches.

**SOMERVILLE,** a N. E. central co. of Texas, intersected by the Brazos river; area, about 300 sq. m. It was formed in 1875 from Hood co. The surface is rolling and the soil fertile. Wheat, Indian corn, and cotton grow well. Capital, Glen Rose.

**SOMERVILLE,** a city of Middlesex co., Massachusetts, on the Mystic river, 2 m. N. W. of the state house, Boston; pop. in 1850, 3,540; in 1860, 8,025; in 1870, 14,685; in 1875, 21,868. It borders S. W. on Cambridge. The surface is uneven; the principal elevations are Prospect, Spring, Central, and Winter hills. A public park of about 16 acres has been laid out in the N. E. part of the city. It is lighted with gas and supplied with water from Mystic pond. It is connected with Boston by three lines of horse cars and four steam railroads. A large portion of the inhabitants do business in Boston. The principal manufacturing establishments are five brick yards, a bleachery and dye works, a leather-currying establishment, an iron foundery, an art foundery, several carriage factories, two manufactories of glassware, and one each of earthenware, grate bars, ice tools, ladders, mats, spikes, brass and copper tubes, steam boilers, &c. The city is divided into four wards, and is governed by a mayor, 8 aldermen, and 16 councilmen. The valuation of property in 1874 was $30,837,700, and the funded debt at the close of the year was $1,419,854. There are 18 public school houses, including a high school, under the control of a committee of three members from each ward; average attendance in 1874, 3,022; expenditures, $86,705 13, of which $55,990 62 were for teachers' wages. The free public library contains about 5,000 volumes. There are two weekly newspapers and 15 churches, viz.: 3 Baptist, 3 Congregational, 2 Episcopal, 4 Methodist, 1 Roman Catholic, 1 Unitarian, and 1 Universalist. The McLean asylum for the insane is in the E. part of the city.—Somerville was set off from Charlestown in 1842, and incorporated as a city in 1872.

**SOMERVILLE, Mary**, a British physicist, born in Jedburgh, Roxburghshire, Scotland, Dec. 26, 1780, died in Naples, Italy, Nov. 29, 1872. She was the daughter of Vice Admiral Sir William Fairfax, and chiefly through her own efforts acquired a thorough education, particularly in mathematics and landscape painting. In 1804 she married Samuel Greig, then Russian consular agent in London, where she went to reside. Left a widow in 1807, she returned to Edinburgh, and in 1812 married her cousin William Somerville, M. D., who in 1816 was appointed a member of the army medical board, and removed to London. Here she attracted attention by some experiments on the magnetic influence of the violet rays in the solar spectrum, the results of which were published in the "Philosophical Transactions" of 1826; and Lord Brougham suggested that she should prepare for the "Library of Useful Knowledge" a summary of the *Mécanique céleste* of Laplace, which proved too voluminous for its original destination, and was published under the title "Mechanism of the Heavens" (8vo, Cambridge, 1831). This work led to her election as an honorary member of the royal astronomical society, and her bust by Chantrey was placed in their hall. In 1834 she published "The Connection of the Physical Sciences" (9th ed., 1858). In 1835 she received a pension of £200, subsequently increased to £300. Soon afterward she went to Italy on account of the health of her husband, and there resided during the rest of her life, principally in Florence, Rome, and Naples. Her next work was "Physical Geography" (2 vols., 1848; 6th ed., 1870), a history of the earth in its whole material organization, and of animal and vegetable life; and her last, "Molecular and Microscopic Science" (2 vols., 1869). She was a member of many foreign societies, and in 1869 received the Victoria medal of the royal geographical society, and in the same year the first gold medal ever awarded by the Italian geographical society. She warmly favored what are popularly known as "women's rights," and was a member of the general committee for woman suffrage in London. In her 92d year she read books in the higher mathematics four or five hours daily, solved the problems, and to the day of her death was occupied in the revision and completion of a treatise on the "Thêory of Differences." During her last few years she noted down some recollections of her life, which have been published under the title "Personal Recollections, from Early Life to Old Age, of Mary Somerville," by her daughter, Martha Somerville (8vo, London, 1873).

**SOMERVILLE, William**, an English poet, born at Edstone, Warwickshire, in 1692, died July 19, 1742. He was educated at Winchester school and New college, Oxford, and settled on a paternal estate in Warwickshire. He lived beyond his means, and finally became intemperate. His "Chase," in blank verse, has often been reprinted. He wrote "Field Sports," describing hawking, and "Hobbinol, or Rural Games," a mock heroic poem.

**SOMME**, a N. department of France, in Picardy, bordering on the departments of Pas-de-Calais, Le Nord, Aisne, Oise, and Seine-Inférieure, and the English channel; area, 2,379 sq. m.; pop. in 1872, 557,015. The surface is generally level, but occasionally diversified. It is divided into two nearly equal portions by the river Somme, which flows through it in a W. N. W. direction. The soil is carefully cultivated, but not naturally fertile. Cider is an important product. Cotton, linen, and woollen goods, iron ware, and beet sugar are manufactured. It is divided into the arrondissements of Amiens, Abbeville, Doullens, Montdidier, and Péronne. Capital, Amiens.

**SÖMMERING, Samuel Thomas von**, a German physiologist, born in Thorn, Jan. 18, 1755, died in Frankfort, March 2, 1830. He studied medicine at Göttingen, and became professor of anatomy at Cassel in 1778, and at Mentz in 1784. In 1790 he began to practise medicine at Frankfort, and returned to that city in 1820 after spending 15 years in Munich as physician to the king of Bavaria, who ennobled him. His works include *Vom Baue des menschlichen Körpers* (5 vols., 1791–'6; new ed., 9 vols., 1839–'44); *De Corporis Humani Fabrica* (6 vols., 1794–1801); and *Ueber das Organ der Seele* (1796), teaching that the soul has its seat in a vapor-like fluid in the cavities of the brain.

**SOMNAMBULISM** (Lat. *somnus*, sleep, and *ambulare*, to walk), literally, the act of walking in sleep, but usually applied to all the movements of a person who while in a condition of sleep acts his dreams. There are three kinds of somnambulism, viz.: 1, simple, where the somnambulist is apparently in ordinary health, but rises from his bed, walks, runs, or climbs, or sometimes talks or writes, while asleep; 2, morbid, where there is a diseased condition, which admits the manifestation of the duality of the human system, the somnambulist sometimes being alternately in the natural and the morbid condition, and frequently while in the latter performing acts of which while awake he is incapable; and 3, artificial, which is treated under ANIMAL MAGNETISM. The first class of somnambulists are usually persons of nervous temperament, and the phenomena are generally induced in them either by some violent excitement, or oftener by a morbid condition of the stomach, late suppers, indigestible food, or the like. Some writers advise the placing a wet cloth before their beds, on which they may step, or waking them suddenly in some other way; but such a course is fraught with great danger, as the shock may prove fatal, or at least permanently injurious.—Morbid somnambulism is a condition concerning which we have little positive knowledge, but the phenomena of which are often very striking. A shy, diffident girl of 14, for instance, of a nervous temperament, but who has exhibited no

extraordinary intellectual powers, and has had but very ordinary education, becomes languid, listless, and pale; complains of pain in the side, and perhaps of an unpleasant feeling in the frontal region; after a while, falling asleep in the daytime, she will rise from her chair, and, imagining herself a preacher to a large audience, go through the preliminary exercises of a religious service, and deliver an extempore sermon, the arrangement and language of which far transcend her waking capacity; and this performance may be repeated daily or every other day. In the case we are describing, which in its general features is similar to a considerable number which have occurred in recent times, the subject recovered her health, and the phenomena ceased after two or three years. In some instances they have been followed by the death of the somnambulist.—The development of the double existence is another of the phenomena of morbid somnambulism, not less remarkable than the preceding, and equally well authenticated. The history of the celebrated seeress of Prevorst, by Dr. Kerner, will be readily recalled; and in many cases the two states are strongly marked, and the subject remains in each for some weeks, being utterly unconscious while in the one of any event which has occurred while in the other. Though resembling it in some particulars, these cases are not to be confounded with those in a state of ecstasy (see CATALEPSY), there being none of the physical insensibility or muscular rigidity. The causes and cure of this form of somnambulism are alike obscure.—See Dr. A. J. Kerner, *Geschichte zweier Somnambulen* (Carlsruhe, 1824), and "The Seeress of Prevorst," translated into English by Mrs. Catharine Crowe (New York, 1845); Macnish's "Philosophy of Sleep" (1830); Abercrombie "On the Intellectual Powers" (1830); Deleuze's "Critical History of Animal Magnetism" (revised ed., New York, 1846); Colquhoun's "Animal Magnetism" (1851); Reichenbach's "Animal Magnetism;" Dr. Sonderis's "Narrative of the Religious Excitement in Sweden;" and Dr. Gibson's "Year of Grace, an Account of the great Irish Revival in 1859" (1860).

**SOMNAUTH,** or **Somnath Pattan,** a walled town of British India, in the peninsula of Cattywar, in the political agency of the same name under the Bombay government, on the N. E. shore of the Arabian sea, 28 m. W. N. W. of Cape Diu, and about 200 m. N.W. of Bombay; pop. about 5,000. Somnauth is celebrated in the mythological legends of ancient Hindostan, and is now chiefly remarkable as the site of a magnificent temple dedicated to Siva, which formerly attracted many pilgrims, and was supported by the revenues of 10,000 villages. It was stormed and robbed of immense treasure by Mahmoud of Ghuzni in 1024, and its gates were carried away as a trophy. They were brought back to India in 1842 by the English, on the evacuation of Afghanistan, and deposited in the magazine at Agra.

**SOMOGY** (Ger. *Schümegh*), a county of S. W. Hungary, bordering on the counties of Zala, Veszprém, Tolna, and Baranya, and on Croatia and Slavonia; area, 2,538 sq. m.; pop. in 1870, 289,555. It is mountainous, and is drained in the south by the Drave. Lake Balaton on the northwest is partly within its limits. The products include grain, wine, tobacco, and timber. Capital, Kaposvár.

**SONATA,** a form of musical composition consisting of several independent movements, each of which is developed in accordance with certain accepted rules. The great body of instrumental music is based upon the sonata form. When first used, in the latter part of the 16th century, the word simply signified a composition for instruments, and conveyed no idea of any determined form. Gradually composers applied it to a composition for one or two instruments, consisting of three movements of contrasted character and time. Philipp Emmanuel Bach contributed greatly to the development of the sonata. His works of this class consisted of a first movement, *allegro*, a second, *adagio*, and a third, *rondo*, which was more vivacious than the others. Haydn adopted Bach's general plan, though in his 44 sonatas he developed the movements in a broader manner. Mozart and Beethoven composed some of their best works in this form; in their day it was the favorite kind of pianoforte composition. It has also been used by Von Weber, Schubert, Schumann, and other later composers. Haydn added a fourth movement, the *minuetto*, and this, or its equivalent the *scherzo*, with the three previously existing movements, constitutes the form upon which all the quartet and quintet music for stringed instruments and the symphony are based.

**SONDERSHAUSEN.** See SCHWARZBURG-SONDERSHAUSEN.

**SONDRIO,** a N. province of Italy, in Lombardy, bounded N. W. and N. by Switzerland, N. E. by Tyrol, and S. by Brescia, Bergamo, and Como; area, 1,262 sq. m.; pop. in 1872, 111,-241. It includes the valleys of the Valtellina (*Val Tellina*), 45 m. long, and its continuation the former county of Bormio, and the valley of Chiavenna, and forms only one district. It is surrounded by branches of the Rhætian Alps, including some of their highest summits, and the carriage roads over the Splügen, Bernina, and Stelvio passes, the last the highest of the Alpine roads, run through the province. The province abounds in picturesque localities. The principal river is the Adda. Excepting along the marshes near the lake of Como, the country is exceedingly fertile in grain and fruit, and especially in wine. The cheese is among the best in Lombardy. Iron and marble abound. The principal towns are Chiavenna, Bormio, and Sondrio, the capital, which has a population of about 5,000, and a fine cathedral. (See VALTELLINA.)

**SONE,** a river of British India, a southern tributary of the Ganges, rises in the high-

lands of the Central Provinces, in lat. 22° 41′ N., lon. 82° 7′ E., near the source of the Nerbudda, and falls into the Ganges 28 m. above Patna, after a course of upward of 450 m. The general direction of its flow is northeasterly, through Jubbulpore, Rewah, and Behar. All its important tributaries come from the south. In the highlands it flows through narrow valleys, but lower down they widen into alluvial plains, which are well cultivated, and yield cotton, indigo, and sugar cane. It is about 3 m. wide at its junction with the Ganges, but the navigation is of little importance above Daudnugur, about 60 m. from that point, where the river is 10 or 12 ft. deep in the rainy season, but at other times nearly dry. Coal is found upon the banks of its upper course, and agates and carnelians occur. Work is now (1876) in progress on the Sone irrigation project for supplying water to about 2,000,000 acres in the Patna division of Bengal, by a dam across the river, and other works.

**SONNEBERG,** a town of Germany, in Saxe-Meiningen, 35 m. S. E. of Meiningen; pop. in 1871, 6,764. It is the centre of an important manufacturing district, and has a fine church, a new town hall, and a new government building. Dolls and toys of wood and papier maché, china goods, cotton hose, and kid gloves are made here in great perfection. The shipments to the United States amounted in 1873–'4 to $938,332 in gold. In the vicinity are marble and other quarries, and there are many breweries. An American consul is stationed here.

**SONNET** (It. *sonetto*), a poem consisting of 14 iambic decasyllabic or endecasyllabic lines, rhyming in a peculiar manner. The first 8 lines make two quatrains, and the remaining 6 two tercets. There are two rhymes in the quatrains, the 1st, 4th, 5th, and 8th lines rhyming together, and also the 2d, 3d, 6th, and 7th. This is the best arrangement, as the Italians hold, but others occur, and sometimes, even in Petrarch, the rhymes are alternate. In the tercets great liberty is allowed; the rhymes may be either two or three, and they may be arranged at the will of the poet, but never in couplets. There are but few Italian precedents for the form which the English poets prior to Milton gave to the sonnet. From the difficulty of continuing the same rhyme, they made it consist of three quatrains and a final couplet, each quatrain usually having its own two alternate and independent rhymes. The Anacreontic sonnet is composed of octo-syllabic lines. It is doubtful whether the sonnet was the invention of the Italians, or was derived by them from earlier Provençal poets. The oldest extant specimens are in Italian, by Lodovico Vernaccia (about A. D. 1200), and by Piero delle Vigne, chancellor of the emperor Frederick II., who flourished early in the 13th century; the first who gave to it the arrangement which was subsequently adopted as its legitimate form was Guittone d'Arezzo (died in 1294); and it was carried to its highest excellence by Petrarch. The Italian sonnet was introduced into Spain by the marquis of Santillana in the 15th century, and during the two following centuries it was regarded there with extravagant favor. It never found much favor in France, and fell into ridicule in the 17th century through the *bouts rimés*, or blank sonnets, in which the rhyming words were first chosen and arranged, while the subject was to be selected and the body of the sonnet to be written afterward. In Germany the sonnet has been chiefly cultivated by the poets of the romantic school. The earlier English form of the sonnet was introduced by Surrey and Wyatt in the reign of Henry VIII.; and there are numerous sonnets by Sidney, Spenser, Shakespeare, Daniel, Drayton, Drummond, and others. Milton returned to the genuine Italian form, but did not always adhere to it. From the time of Milton for nearly a century few sonnets were written in England. It was revived in the Italian form by Edwards, Gray, and T. Wharton, while Bowles, Charlotte Smith, and Helen Maria Williams reverted to the easier form of the old English sonnets.—See "The Sonnet: its Origin, Structure, and Place in Poetry, with original Translations from the Sonnets of Dante and Petrarch," by Charles Tomlinson (London, 1874).

**SONNINI DE MANONCOURT, Charles Nicolas Sigisbert,** a French naturalist, born in Lunéville, Feb. 1, 1751, died in Paris, May 29, 1812. Being commissioned as a marine engineer, he spent several years in Cayenne and on the W. coast of Africa, afterward passed some time with Buffon, and in 1777 joined the African expedition under Baron de Tott. After visiting Egypt, Greece, and Asia Minor, he returned to France in 1780. He contributed to Buffon's *Histoire naturelle* 13 volumes of fishes, 1 of cetacea, and with Latreille 4 of reptiles. He lost his fortune by the revolution, and afterward edited a *Bibliothèque physico-économique* (1801–'12), and *Nouveau dictionnaire d'histoire naturelle* (24 vols. 8vo, 1803 *et seq.*), and published accounts of his travels.

**SONNTAG, William Louis.** See p. 891.

**SONOMA,** a N. W. county of California, bounded S. E. by San Pablo bay and W. by the Pacific ocean, and watered by Russian, Santa Rosa, Petaluma, and Sonoma rivers; area, 1,400 sq. m.; pop. in 1870, 19,819, of whom 473 were Chinese. The N. part is traversed by well timbered spurs of the Coast range. The valleys are very fertile, and Sonoma valley is celebrated for its vineyards. In the N. E. part of the county are the geysers, a collection of hot springs. Gold, silver, copper, quicksilver, and coal occur, but not generally in paying quantities. The county is traversed by the San Francisco and North Pacific railroad. The chief productions in 1870 were 618,425 bushels of wheat, 145,792 of Indian corn, 323,961 of oats, 195,456 of barley, 369,154 of potatoes, 308,496 gallons of wine, 230,394 lbs. of wool, 1,060,266 of butter, 246,900 of cheese, and

35,571 tons of hay. There were 10,616 horses, 1,110 mules and asses, 14,960 milch cows, 16,592 other cattle, 58,387 sheep, and 28,588 swine; 4 manufactories of carriages and wagons, 5 of cooperage, 5 of cabinet furniture, 1 of iron castings, 5 of wine, 13 of saddlery and harness, 2 of sash, doors, and blinds, 8 of tin, copper, and sheet-iron ware, 5 flour mills, 4 tanneries, 3 currying establishments, 3 breweries, and 18 saw mills. Capital, Santa Rosa.

**SONORA,** a N. W. state of Mexico, bounded N. by the United States, E. by Chihuahua, S. by Sinaloa, and W. by the gulf of California and Lower California; area, 81,022 sq. m.; pop. in 1869, 109,388. The eastern portion of the state is extremely mountainous, being traversed by a branch of the Sierra Madre; the western is composed mainly of extensive plains. The principal rivers are the Mayo, Yaqui, and San José, the second having a course of 450 m., and all three emptying into the gulf of California. The most important mineral productions are gold and silver, of which there were 144 mines in 1870; the coinage of the mints of Hermosillo and Álamos in 1869 amounted to $1,116,397. Copperas occurs in some places, as do also amianthus, alabaster, and jasper; and carbonate of soda and nitrate of potash are found. The climate is hot on the coast, mild in the central portions, and cool in the elevated region of the east. Much of the soil is fertile, but agriculture is chiefly confined to the southern districts watered by the Mayo and Yaqui rivers. The staple productions are wheat, maize, barley, oats, beans, sugar, cotton, and tobacco; coffee is raised, and fruits are very abundant. There are extensive forests, but little of the timber is suitable for building; copal, gum arabic, archil moss, cochineal, and many other dyes and drugs are produced. Seals, turtles, oysters (including pearl oysters), and fish of good quality are found in inexhaustible quantities. There are seven steam and a large number of other flour mills; coarse cotton fabrics are manufactured in a mill of 60 looms at San Miguel, the only factory of any kind in the state; and large quantities of cigars are made. Cattle rearing is extensively carried on, despite the depredations of the Apache and other Indians. The exports include hides, gold and silver coin and bullion, ores, hog skins, pepper and gum, flour, and cigars. In 1870 there were 105 schools, with an attendance of 3,871. The state is divided into eight districts: Ures, Hermosillo, Guaymas, Álamos, Montezuma, Zaguarita, Arispe, Altar, and Magdalena. The capital is Ures; the chief seaport, Guaymas.

**SONTAG, Henriette,** Countess Rossi, a German singer, born in Coblentz, Jan. 3, 1806, died in Vera Cruz, Mexico, June 18, 1854. She appeared upon the stage in children's parts as early as her sixth year, at 15 made her début at Prague in Boïeldieu's "John of Paris," and soon rose to a foremost place among European vocalists. In 1828 she privately married Count Rossi, an Italian nobleman, and in 1830 retired from the stage. She was induced by her husband's pecuniary misfortunes to resume her profession in 1849, sang for several seasons in Europe, then made a successful tour in the United States, and died while returning from a professional visit to Mexico.

**SOOCHOW,** or **Suchau,** a city of China, in the province of Kiangsu, on a lake through which the imperial canal passes, 112 m. E. S. E. of Nanking, and 53 m. W. by N. of Shanghai; pop. variously estimated from 500,000 to 2,000,000. It consists of the town proper, surrounded by a wall 10 m. in extent, and four extensive suburbs. Silk, linen, cotton hardware, and glass are manufactured. There are many beautiful gardens in the neighborhood. It suffered severely during the Taeping rebellion, the insurgents occupying it and driving out the merchants and wealthy inhabitants. It succumbed with other cities of the delta to the imperialists in 1864, and since then has recovered much of its prosperity.

**SOODAN,** or **Soudan** (Arab. *Biled es-Sudan*, the country of the blacks). **I.** A vast continental belt of territory (also called Nigritia), stretching nearly across Africa, mainly between the 6th and 15th parallels of N. latitude, from the Nile provinces of Egypt on the east to the Mandingo country and Senegambia on the west. In Waday and near Timbuctoo its northerly boundary is not far from lat. 17° N. This region is occupied by a large number of native states, of which the most important are Adamawa, Baghirmi, Bambarra, Bornoo, Darfoor, Gando, Houssa, Sackatoo, and Waday, each described under its own title. The altitude of Soodan and the aspect of the surface vary greatly in the different districts. The portion W. of the Niger is bounded S. by the Kong mountains, which curve northward into the highlands of Senegambia, forming the W. boundary. The region enclosed within the great bend of the Niger is of moderate elevation, and consists of a series of well watered and fertile plains, in some places densely populated. The central portion of the country extends E. from the river as far as Lake Tchad, in which centres the hydrographic system of this part of Soodan. The surface is hilly except in the vicinity of the lake, but the altitude is believed not to exceed 2,000 ft., and probably does not average more than half as much. Among the hills are numerous torrent beds filled only in the rainy season. There are swamps in the lower districts, and an abundant forest growth, but the cleared area is sufficient to render central Soodan both populous and productive. Lake Tchad, which is intersected by the 14th parallel of N. latitude and the 15th meridian of E. longitude, is bordered N. E. by the native state of Kanem, beyond which lies the Sahara, S. E. by Baghirmi, and on all other sides by Bornoo. It is about 840 ft. above the sea level, and its numerous affluents drain the vast alluvial plain surrounding

it, which slopes gently toward its shores. (See TCHAD, LAKE.) The principal tributary is the Shary, flowing into the lake from the south. The plain is subject to frequent inundation in the vicinity of the streams, but is fertile and thickly inhabited. In Waday, which borders it on the east, the country becomes hilly again, and so continues some distance beyond the confines of Darfoor. The Nyam-Nyam country, lying principally S. of lat. 5° 30′ N. and E. of the 25th meridian, is drained by the westward-moving river Welle, discovered by Schweinfurth, and belongs geographically to Soodan, if that stream is connected with the system of Lake Tchad.—The geology of Soodan is but little understood, and the mineral wealth seems limited to iron, which appears to be widely diffused, and gold, which is found in the rivers. The climate is everywhere characterized by extreme heat and moisture. The maximum temperature is attained in the level region of central Soodan, where the annual mean is over 83° F., while the more western hilly country is remarkable for its excessive moisture and a greater range of the thermometer. The rainy season, which abounds in thunder storms and tornadoes, lasts from the middle of May or June, varying with the region, to November, when the northerly winds set in, and the weather becomes fair and dry. The natural products comprise palm oil, cocoanuts, dates, figs, and many other tropical fruits. The chief cultivated crops are maize, millet, yams, rice, wheat, beans, tobacco, cotton, indigo, and various vegetables. The fauna of Soodan embraces the larger mammalia, such as the elephant, hippopotamus, and rhinoceros; the lion, leopard, and spotted hyæna, among the carnivorous animals; numerous species of antelopes; and the ostrich, on the borders of the desert. Domestic animals are extensively raised, including several breeds of horses and innumerable cattle, as well as goats, sheep, asses, and poultry. The honey made by wild bees is gathered in large quantities, and forms an important article of native traffic. The external trade of Soodan is carried on principally by means of caravans, which journey to and from Algeria and Morocco. The exports comprise attar of roses, gold dust, gum arabic, indigo, ivory, and ostrich feathers and skins, of which about £1,500,000 worth annually reaches Algeria; the imports from that country average about the same amount, mainly in cotton goods, cutlery, and weapons. Inferior iron utensils and coarse cotton cloth are the only noteworthy articles of native manufacture. The population consists chiefly of negroes, but in the west the Mandingoes predominate, and the Foolahs are the ruling people in Gando, Sackatoo, and Adamawa. In many parts of the country the Arabs are extremely influential.—Soodan has yet to be thoroughly and exhaustively explored throughout. Among the more prominent European travellers who have visited or traversed some portion of the country are Mungo Park, Denham and Clapperton, Caillié, Lander, Barth, Vogel, Rohlfs, and Nachtigal (1869–'74). The last named entered Bornoo from the Sahara N. of Lake Tchad, and made his way thence eastward through Waday and Darfoor to the Nile, an undertaking never before accomplished. The explorations of Petherick and Schweinfurth relate to regions S. of the limits usually assigned to Soodan. **II.** A province of Egypt, distinguished from the preceding, of which it is but a continuation eastward, by prefixing the definite article (the Soodan). It comprises Kordofan, Nubia proper, Sennaar, Taka on the east, and some Nile districts further south; pop. estimated by Sir Samuel Baker at over 1,000,000. The soil is fertile, and would be productive under just rule, but the exactions of the government have been so excessive as greatly to retard the development of the province. The khedive has undertaken the construction of a railway from Shendy, N. of Khartoom, the capital, down the Nile a distance of about 220 m., to a point below the second cataract. The products of the Soodan have hitherto found their way to Cairo mainly by means of caravans occupying four months on the journey. According to an official statement of such products sold in that city in 1873–'4, they were valued at £1,550,600, and comprised ostrich feathers (worth £824,013), gums, ivory, calf skins, coffee, senna, wax, tamarinds, and many other articles. This statement did not include exports from the Soodan through the Red sea ports. The province has been gradually annexed by Egypt since 1821.

**SOOFEES.** See SUFIS.

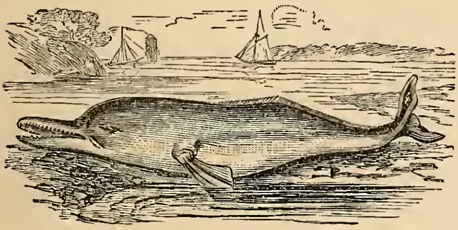
**SOOLOO,** or **Sulu**, the general name of a picturesque chain of islands in the Indian archipelago, known also as the Sooloo archipelago, extending about 250 m. from S. W. to N. E., between Borneo and Mindanao, from lat. 4° 40′ to 6° 45′ N., and from lon. 119° to 122° 20′ E., separating the Celebes sea on the south from the Sooloo or Mindoro sea on the north; estimated area, 1,300 sq. m.; pop. about 200,000. They lie outside the volcanic belt of the Indian archipelago. The entire number of islands is about 150, most of which are small and uninhabited. There are three large islands: Tawi, near the coast of Borneo; Basilan, close to the S. W. extremity of Mindanao; and Sooloo, about midway between them. Each is about 40 m. long and from 6 to 20 m. wide, richly clothed with tropical vegetation, and rising into peaks of considerable height, those in Sooloo being 2,000 ft. above the sea. The island of Cagayan Sooloo, 140 m. N. W. of the main chain, is sometimes included within the Sooloo archipelago, although it does not properly belong to it. Balambangan island, further west, near Maludu bay in Borneo, is noted for the two unsuccessful attempts of the British to establish themselves there. It was ceded to England in 1763, but the fortifications were destroyed by the Spaniards in 1775; it was re-

settled in 1803, but abandoned in 1804. The Sooloo archipelago lies within the influence of the monsoons. The thermometer ranges between 75° and 87°. The chief productions consist of teak and sandal wood, rice, tortoise shell, pearls, mother of pearl, fish, tripang, and edible birds' nests. According to Mr. St. John, this archipelago furnishes probably a greater number of valuable oyster beds than any other part of the world. The islands are subject to the sultan of Sooloo, and are governed by numerous petty chiefs. The fortified town of Sugh or Sooloo, on the island of the same name, is the capital and chief port of the group, and carries on considerable trade with the other islands and Manila. Its population is about 6,000, and that of the whole island is estimated at 100,000. The inhabitants are Mohammedan Malays, and were renowned for their piratical habits prior to the repression of piracy in these waters by the Spanish in 1851. They write their language, which appears to resemble the Philippine tongue, in the Arabic character.

**SOONGARIA,** or **Dzungaria.** See TURKISTAN.

**SOONNA.** See SUNNA.

**SOOSOO,** or **Sousou,** the native name of the dolphin of the Ganges, a fresh-water cetacean of the genus *platanista* (F. Cuv.). In this, the only described species (*P. Gangetica*, F. Cuv.),



Soosoo, or Dolphin of the Ganges (Platanista Gangetica).

the body is from 20 to 24 ft. long, thickest in front and gradually tapering to the tail; the head obtuse; the jaws nearly equal, almost straight, slender, compressed at the sides, expanded at the end, and from 3 to 4 ft. long; the teeth are $\frac{30}{30}-\frac{30}{30}$, conical, projecting from the gums, largest, nearest together, and most curved in front, interlocking in the two jaws, and laterally near together in the lower jaw; the symphysis very long; the blow-hole a longitudinal fissure, an unusual form; eyes very small, shining black, deeply sunk, and 4 in. above the angle of the mouth; auditory foramina open but small; the pectorals fan-shaped, 1½ ft. long and 1 ft. broad posteriorly; dorsal much depressed and nearest the tail; caudal 2½ ft. wide and festooned. The color is shining pearly gray, with a few lighter colored spots; the fat under the skin is highly prized by the Hindoos as an external application in painful diseases. It is carnivorous, feeding principally on fish, in the pursuit of which it is very active, but at other times is rather slow. It inhabits the Ganges as far as the head of navigation, but is most abundant where its numerous mouths open into the sea.

**SOOTHSAYER.** See MANTIS.

**SOPHIA** (Bulg. *Triaditza*), a town of European Turkey, in Bulgaria, on a small affluent of the Isker, 310 m. W. N. W. of Constantinople; pop. estimated from 18,000 to 30,000, including Bulgarians, Turks, Greeks, and Armenians. It is beautifully situated on the road to Belgrade and surrounded by mountains. The old castle was fortified in 1854. The principal mosque was formerly the magnificent church of St. Sophia. A Greek archbishop and a Catholic bishop reside here. S. of the city are extensive ruins of the ancient Sardica or Ulpia Sardica, an important town of Mœsia, in which a council was held in 347. Sophia was founded by Justinian, and conquered by the Bulgarians in 809 and by the Turks in 1382. For a long time it was the capital of Bulgaria.

**SOPHIA ALEXEYEVNA.** See PETER I.

**SOPHIA DOROTHEA,** crown princess of Hanover, born Sept. 15, 1666, died Nov. 13, 1726. She was a daughter of Duke George William of Brunswick, of the Lüneburg-Celle line; her mother was a French lady. In 1676 she was affianced to a prince of the house of Brunswick, who died in the same year. She was married in 1682 to her cousin, the future George I. of England, and became the mother of George II. and of the queen of Frederick William I. of Prussia. She lived unhappily with her husband, from whom she was divorced in December, 1694, after being suspected of an intrigue with Count Königsmark. The latter had disappeared in the night of July 1–2 of that year on leaving Sophia's apartment, and it was generally believed that he had been assassinated at her father-in-law's instigation. She was banished for the rest of her life to the castle of Ahlden, near Celle, whence her popular designation as princess of Ahlden.

**SOPHISTS.** See PHILOSOPHY, vol. xiii., p. 437.

**SOPHOCLES,** a Greek tragic poet, born in the Attic village of Colonus in 496 or 495 B. C., died probably in 406. He was about 30 years younger than Æschylus, and 15 years older than Euripides. Having gained the prize of a garland both in music and gymnastics, he was selected for his beauty and musical skill in his 16th year to lead, naked, anointed, and with lyre in hand, the chorus which danced and sang around the trophy in the celebration of the victory of Salamis. In 468 he first came forward as a competitor in a dramatic contest, having Æschylus for his rival. The representation was at the great Dionysia, presided over by the first archon; the judges were Cimon and his colleagues who had just returned from the conquest of Scyros, bringing with them the bones of Theseus; the play presented by Sophocles was probably the "Triptolemus," celebrating the Eleusinian hero as a patriot and civilizer; the public interest and expecta-

tion were strongly excited; and the first prize, which for a whole generation had belonged to Æschylus, was now awarded to his youthful rival. From this time to 441 he is said to have written 31 plays. In 440 "Antigone," his earliest extant drama, gained the prize, and so delighted the Athenians that they elected him one of the ten strategi for the ensuing year. He engaged as the colleague of Pericles in the Samian expedition, but neither achieved nor sought military reputation. He was familiar with Herodotus, and wrote a poem in his honor. Ruhnken supposes that it was not the poet, but an orator of the same name, who after the destruction of the Sicilian army in 413 favored the oligarchical movement and was appointed one of the ten *πρόβουλοι.* Sophocles refused repeated invitations to leave Athens and reside at foreign courts. During the 34 years following the success of "Antigone" he produced 81 dramas. Contending, besides Æschylus, with Euripides, Chœrilus, Aristias, Agathon, and his own son Iophon, he gained the first prize 20 or 24 times, and the second in all other cases. At an advanced age he filled the office of priest to the native hero Halon. There is no certain authority for any of the accounts of his death, that he was choked by a grape, that he sustained his voice so long in publicly reading the "Antigone" as to lose his breath and life together, or that he died of joy on obtaining a dramatic victory. It has been said that he combined all the qualities which, in the judgment of a Greek, would make up a perfect character: beauty and symmetry of person, mastery alike in music and gymnastics, spontaneity of genius and faultlessness of taste, constitutional repose, a habit of tranquil meditation, a ready wit, and an amiable demeanor.—Sophocles is placed by the universal consent of ancient and modern critics at the head of the Greek drama. His tragedies hold the just mean between the vague and solemn sublimity of Æschylus and the familiar scenes and rhetorical pathos of Euripides, presenting the characters of men worthy of sympathy and admiration, while the former delighted in religious themes fit to inspire awe, and the latter abounds in unpoetical disquisition and immoral vehemence of passion. He illustrates the age of Pericles, intervening between that of the heroes of Marathon and Salamis and that of the sophists. Of all his dramas only seven have been preserved, to which Müller assigns the following chronological order: "Antigone," "Electra," "Trachinian Women," "King Œdipus," "Ajax," "Philoctetes," and "Œdipus at Colonus." They all belong to the latter period of his life and reveal his art in its full maturity, and several of them were esteemed by the ancients among his greatest works. The "Œdipus at Colonus" was first brought out by his grandson after his death. There are also fragments and titles of his lost plays. The *editio princeps* of Sophocles is that of Aldus (1502). The text of Turnebus's edition (1533) served as a basis for the subsequent editions of Henry Stephens (1568), Canterus (1579), and others, until the edition of Brunck (2 vols., Strasburg, 1786), which is the basis of all later editions. Among the best are those of Hermann (4th ed., Leipsic, 1851), Dindorf (new ed., Leipsic, 1867), Tourneur (Paris, 1873), Schneidewin (4th ed. by Nauck, Berlin, 1873), Campbell (Oxford, 1873–'4), Blaydes (London, 1873–'4), and White (Boston, 1874). The best translations are: in German, by Jordan (Berlin, 1862), Schöll (new ed., Leipsic, 1871), and Donner (7th ed., Leipsic, 1873); in French, by Fayart (Paris, 1849), Artaud (6th ed., 1862), and Personneaux (2d ed., 1874); and in English, by Adams (London, 1729), Franklin (1758–'9), Potter (1788), Dale (1824), Buckley (Bohn's "Classical Library," 1849), Plumptre (1866–'71), Collins ("Ancient Classics for English Readers," London and Philadelphia, 1873), and Campbell (1874).

**SOPHOCLES, Evangelinus Apostolides,** an American scholar, born near Mt. Pelion, in Thessaly, March 8, 1807. He studied in the convent on Mt. Sinai, emigrated to the United States, entered Amherst college in 1829, taught school, and was tutor in Greek in Harvard college in 1842–'5 and 1847–'59. He was then appointed assistant professor of Greek there, and in 1860 professor of ancient, Byzantine, and modern Greek. He received the degree of A. M. from Yale college in 1837 and from Harvard college in 1847, and that of LL. D. from the Western Reserve college in 1862 and from Harvard college in 1868. He has published "A Greek Grammar" (Hartford, 1838; 3d ed., 1847); "First Lessons in Greek" (1839); "Greek Exercises" (1841; 3d ed., 1848); "A Romaic Grammar" (1842; 2d ed., Boston, 1857, and London, 1866); "Greek Lessons for Beginners" (Hartford, 1843); "Catalogue of Greek Verbs" (1844); "History of the Greek Alphabet, with Remarks on Greek Orthography and Pronunciation" (Cambridge, 1848; 2d ed., 1854); "A Glossary of Later and Byzantine Greek" (4to, Boston, 1860, forming vol. vii., new series, of the "Memoirs of the American Academy"); and "Greek Lexicon of the Roman and Byzantine Periods" (8vo, Boston, 1870), his chief work.

**SOPHONISBA.** See Masinissa.

**SORACTE** (now *Monte di Sant' Oreste*, and sometimes *Monte di San Silvestro*), a mountain of ancient Etruria, in the territory of the Falisci, visible from and about 25 m. N. of Rome. It rises in an abrupt mass to a height of about 2,250 ft. It was consecrated to Apollo, who had a temple on its summit, where the present monastery of San Silvestro stands.

**SORBONNE,** the principal school of theology in the ancient university of Paris. It was founded in 1253 by Robert de Sorbonne or Sorbon, so called from his birthplace in Champagne. He had been a poor student, but became chaplain to Louis IX. in 1252, and found-

ed with the king's aid a collegiate school for the gratuitous education of poor students in theology. He secured the services of three secular professors, Guillaume de Saint-Amour, Eudes de Douai, and Laurent Langlois, and formed with them, and 16 poor students under his own direction, a community which served as a model for similar collegiate schools in the universities of France and England. The charter granted in 1253 by Louis IX. was confirmed and enlarged by Pope Clement IV. in 1268. Before 1253 theological instruction was given in the bishop's school near the cathedral of Notre Dame; thenceforward it was given exclusively at the Sorbonne. Robert also founded near the college a preparatory seminary called "the little Sorbonne," which was destroyed in 1635, when the present church of the Sorbonne was erected on its site. He provided a library of 1,000 volumes, which was increased by subsequent benefactors, especially by Cardinal Richelieu. The members of the college (*maison de Sorbonne*) were divided into fellows (*socii*) and commoners (*hospites*). The fellows, composing the faculty, were all secular priests, doctors or bachelors in divinity, selected for their eminent learning, after undergoing the test of a severe public examination, a triple ballot, and teaching a course of mental philosophy. Besides the strict necessaries of life provided in the college, the poorest among them received a trifling stipend. The commoners were required to be bachelors in divinity, were chosen from among the most talented of their class after the most rigorous ordeal, and were maintained by the college, but had no voice in its government. The fellows were nominated for life, and were officially designated "fellows or bachelors of the house and society of the Sorbonne;" the commoners were styled "bachelors of the house of the Sorbonne," and their membership ceased on their graduating as doctors. The college property was vested in the fellows, and all business was managed in their name. A perfect equality reigned among them; the holding of office implied no superiority or power of one over another. No member of a religious order was admitted into their body, and a fellowship was forfeited by entering such an order. The exceeding rigor exercised in the selection both of fellows and of commoners was for the purpose of maintaining a high standard of intellectual culture among the secular priesthood. But the vast lecture halls attached to the college were open to all poor scholars indiscriminately, and the professors were pledged never to refuse to teach any such, while students who had means were required to pay the usual university fees. From 1253 to 1789 at least six doctors of the Sorbonne were constantly employed in giving gratuitous instruction. The high standard of excellence thus maintained by the faculty, and the large number of distinguished scholars who went out from the Sorbonne to fill the highest ecclesiastical and civil offices in every European country, raised this celebrated school to an unrivalled pitch of fame and influence all through the middle ages and down almost to its suppression. Its controlling power was felt in the contests between the university of Paris and the mendicant orders, Guillaume de Saint-Amour being the chosen advocate of the former and the uncompromising foe of the friars; the Sorbonne was appealed to in the disputes between the civil powers and the papacy, and in the great theological controversies and long schisms that divided the church. It opposed the claims of ultramontanism, decided against the divorce of Henry VIII. from Catharine of Aragon, condemned the docrines of Luther, Calvin, Baius, Jansenius, and Quesnel, sustained the Catholic league against Henry of Navarre, and declared in 1588 that Henry III. had forfeited the crown. The Sorbonne was specially favored by Cardinal Richelieu, who rebuilt on a magnificent scale the college, lecture halls, and church, besides enlarging the library. The first works printed in France were from the presses of the Sorbonne. These were established in 1469 by Jean de la Pierre, prior of the Sorbonne, and Guillaume Fichet, rector of the university. In 1470 they published *Gasparini Pergamensis Epistolarum Liber*, followed by other publications in Latin, French, Greek, and Hebrew. The Sorbonne was suppressed in 1789, and at the organization of the modern university of France by Napoleon I. its buildings became the seat of the faculties of science, letters, and theology of the *académie universitaire;* but the faculty of theology is scarcely a shadow of its predecessor.

**SOREL,** a town and the capital of Richelieu co., Quebec, Canada, on the E. bank of the Richelieu river, at its mouth in the St. Lawrence, 45 m. below Montreal; pop. in 1861, 4,778; in 1871, 5,636. It occupies the site of a fort built by the French in 1665, and was for many years the summer residence of the governors of Canada. Nearly all the shipping plying between Quebec and Montreal winters here. Ship building is largely carried on. The town contains manufactories of engines, mill machinery, stoves, ploughs, leather, bricks, &c., several saw and grist mills, two branch banks, a tri-weekly (French) and two weekly (one French) newspapers, a monthly periodical (French), and three or four churches.

**SOREL, Agnes.** See AGNES SOREL.

**SORGHUM,** a genus of grasses, of the tribe *andropogoneæ*, and by some authors included in *andropogon*. In grasses of this genus the flowers are in open panicles, the spikelets two or three together, the lateral ones sterile, or reduced to mere pedicels, the central or terminal one fertile; the stems not hollow, as in most grasses. A single species, *S. nutans*, known as Indian grass and wood grass, having a stalk 3 to 5 ft. high, and a panicle of shining russet-brown flowers, is common throughout most of the states. The name sorghum is in

common use for a sugar-producing grass which is a variety of *S. vulgare.* Sugar cane, *saccharum officinarum*, is a grass closely related to *sorghum*, and neither plant is known in the wild state. The common sorghum, *S. vulgare*, is a poorly defined species, and presents varieties so marked that, did not intermediate forms connect them, it would be difficult to regard them as belonging to the same species. One form, known as Indian millet, and in the East as *durra*, is cultivated in southern Europe, and in Asia Minor, India, and other parts of the East, where it takes the place of the cereals of northern climates; the abundant round, hard seeds afford a very white flour, which makes good bread; the seeds are also used for feeding domestic animals. In the West Indies it is cultivated as food for laborers under the name of Guinea corn, but the grass called by that name in our southern states belongs to a different species. The Indian millet is sometimes cultivated in this country as food for poultry; half a century ago it was introduced as chocolate corn, its seeds being roasted and used as a substitute for coffee; and the seeds are sometimes offered by speculators as Egyptian wheat, or with some other attractive name, at high prices. Another variety, with long straight branches to the panicle and small seeds, is the broom corn. The variety generally known as sorghum (also called sorgho and Chinese sugar cane) is *S. vulgare*, var. *saccharatum*, and is remarkable for its very sweet juice; this has been in cultivation in China, and especially in Africa, from very early times; in Africa, where it is called *imphee*, there are numerous subvarieties known to the natives by such names as *vim-bis-chu-a-pa*, *nee-a-za-na*, *oom-see-a-na*, &c., differing in size, productiveness, and shape of seed cluster, much as do our varieties of maize. An attempt was made to introduce sorghum into Europe as early as 1786, by Prof. Arduino of Florence, but it did not receive much attention until 1851, when Count de Montigny, French consul at Shanghai, sent seeds to Paris; it is said that only one seed out of this lot germinated, and the product of this supplied all the seed sown at first in Europe and America. In 1856 some of this seed was obtained from France by the United States patent office, and distributed; but a much greater dissemination was made by Mr. Orange Judd of New York, who imported a large quantity and distributed 25,000 packets to the subscribers to his paper, the "American Agriculturist," in all parts of the country. In 1857 Mr. Leonard Wray, an Englishman, arrived in New York with the seeds of several varieties of imphee from the south of Africa, some of which are named above; they were tested by several persons, especially in the southern states, and were found to be a promiscuous and carelessly collected lot, which at once brought all kinds of imphee into disrepute; and though one or two selections from these varieties have been cultivated, the main crop is of the Chinese variety. The plant grows from 8 to 18 ft. high, and before the seed cluster shows has much the appearance of maize. In some varieties the branches of the panicle are long, slender, and spreading, in others short and erect, and in some long and drooping to one side; the color of the seed varies from white, through shades of brown, to nearly black; in the true Chinese the panicle is pyramidal, with long, not crowded branches, and the clear brown seeds enclosed in a shining black hull. It will grow wherever Indian corn can be cultivated, but it does not usually ripen its seeds

Chinese Sugar Cane (Sorghum vulgare, var. saccharatum).

north of lat. 41°; it does best on a light warm soil, which should be well fertilized, but not with coarse manures: it is sown in drills or in hills the same as corn, and the crop should be kept clean in the same manner; the plants when they first come up are small, and may be mistaken for some worthless grass. The stalks are cut up at the ground before hard frosts, stripped of their leaves by the use of a fork or machine made for the purpose, and taken to the mill, or stored until they can be pressed. Its sugar, at least soon after pressing, is almost wholly a form of glucose, and the yield of cane sugar, at least in the plant as

grown in this country, is much too small to make its extraction profitable; and the plant is now cultivated for the sirup or molasses. Well ripened canes yield about one half their weight in juice, of which from 5 to 10 gallons, according to the soil and climate, will make one gallon of sirup; the yield of sirup averages from 150 to 175 gallons to the acre, though in exceptional cases the returns are much larger. The sirup varies, according to the care and skill given to its manufacture, from a dark greenish brown color with a repulsive grassy flavor, to a fine amber-colored, honey-like fluid, which, having no characteristic flavor, is preferred by many to any other sirup. The evaporators now in use allow the juice to be concentrated without undue exposure to heat, while the scum is readily removed; lime is used in correcting the acidity of the juice, which for the finest product is filtered through animal charcoal. The total production of sorghum molasses in the United States was 6,749,123 gallons in 1860, and 16,050,089 in 1870. Of the latter amount Indiana produced 2,026,212 gallons, Ohio 2,023,427, Illinois 1,960,473, Kentucky 1,740,453, Missouri 1,730,171, Tennessee 1,254,701, and Iowa 1,218,635. As fodder it is not always relished by cattle, and it is now regarded as less valuable than maize. The seeds are fed to poultry, cattle, and hogs, and bread has been made from the flour. The begasse, or refuse from the press, has been used to make the coarser kinds of wrapping paper; the scum and washings of the evaporators are converted into vinegar. In France sorghum has been cultivated as a source of alcohol.

**SORIA.** **I.** A N. province of Spain, in Old Castile, bordering on Burgos, Logroño, Saragossa, Guadalajara, and Segovia; area, 3,836 sq. m.; pop. in 1870 (estimated), 158,699. Mountains border three sides, and the surface is broken. The Douro rises near the N. boundary, and flows first mainly S. and then W. into the province of Burgos. There are large forests of pine, oak, and beech. The roads are mere tracks, only practicable for mules. **II.** A city, capital of the province, on an irregular eminence on the right bank of the Douro, 113 m. N. E. of Madrid; pop. about 5,500. It is surrounded by old walls. The site of ancient Numantia is supposed to have been a few miles N. of Soria, but no positive traces of it remain.

**SORREL,** the plant *rumex acetosa*, a native of Europe, Asia, and arctic America, which has long been in cultivation. The genus *rumex* (the ancient Latin name) belongs to the *polygonaceæ* or buckwheat family, and consists of more than 100 species, several of which, either indigenous or introduced, are found all over this country and are popularly known as docks. Sorrel is a perennial, with a tuft of radical leaves which are 4 in. or more long, and arrow-shaped at the base; its flower stalks are 2 ft. or more high, bearing leafless panicles of unisexual, diœcious, or sometimes monœcious flowers, which are apetalous, small, and greenish, often turning red; the calyx deeply six-cleft, the three inner segments en-

Sorrel (Rumex acetosa)—the variety called "Belleville."

larging in fruit, orbicular, and somewhat petal-like, enclosing the triangular nut. The leaves are pleasantly sour, owing to the presence of the acid oxalate of potash. In France half a dozen varieties of this are cultivated, of which the Belleville is the most popular. Though sorrel is rarely eaten by the English, the French regard it as one of the necessaries of life. It is used in salads and in soups, but more commonly it is dressed in the same manner as spinach; if too strongly acid when pure to suit the taste, it is mixed with spinach or patience dock. While it is comparatively little known in this country, its use is increasing, and it is now quite regularly found in the markets.—Sheep sorrel belongs to the

Sheep Sorrel (Rumex acetosella).

same genus, and is *R. acetosella*, introduced from Europe, and one of the well known weeds of agriculture; it grows from a few inches to a foot or more high; the lower leaves are

halberd-shaped; its diœcious flowers in slender panicles, the fertile ones turning reddish. The herbage of this is also sour, and where it is abundant and luxuriant is sometimes used by Europeans as a substitute for the garden sorrel; children often eat the pleasantly sour leaves. In some countries the juice of this, as well as of the preceding, is used to curdle milk. As a weed the plant is most abundant upon worn-out soils. Wood sorrel is described under OXALIS. (See also TREE SORREL.)

**SORRENTO** (anc. *Surrentum*), a city of S. Italy, in the province, on the S. side of the gulf, and 16 m. S. E. of the city of Naples; pop. about 4,300, besides many strangers attracted by the climate and the picturesque situation. Deep ravines around the city are excavated in the volcanic tufa. In the vicinity are sea baths, curious grottoes, and relics of antiquity, the principal of which is a reservoir still used. Sorrento is the seat of an archbishop, and has a fine cathedral. The house in which Tasso was born, on the cliff overhanging the sea, is now a favorite hotel. Celebrated inlaid woodwork and silk and other goods are made here. —Under the Romans Surrentum was chiefly known as a fashionable resort, and for its pottery and medicinal wines. In A. D. 79 the eruption of Vesuvius caused great damage to it. In the middle ages it had considerable commerce. The geology of Sorrento has been described by Puggaard (Copenhagen and Leipsic, 1858).

**SOTHERN, Edward Askew**, an American actor, born in Liverpool, Eng., April 1, 1830. He first appeared on the stage in the United States as Dr. Pangloss at the Boston National theatre, in September, 1852. He was a stock actor in Barnum's museum, New York, till 1854, when he joined Wallack's company. For years he was known as Douglas Stewart, and it was not till 1858 that he used his own name. On Oct. 18, 1858, in Tom Taylor's comedy "Our American Cousin," the character of Lord Dundreary was assigned to Sothern. The part as originally written consisted of a few lines, and was assumed by Sothern under protest; but his lisp, drawl, peculiar skip, and many absurdities were very successful, and the part being enlarged, the play ran for 140 consecutive nights. On Nov. 11, 1861, he appeared as Lord Dundreary at the Haymarket theatre, London, and repeated the part 496 consecutive nights. He returned to the United States, and for many months performed Dundreary in the leading cities. On Oct. 10, 1874, he reappeared in the Haymarket, and during a short engagement presented the part of "Brother Sam," written for him by John Oxenford. He returned to New York for the season of 1874-'5, playing Dundreary and Garrick in Wallack's theatre.

**SOTO.** See DE SOTO.

**SOTWELL, Nathaniel.** See SOUTHWELL.

**SOUBISE. I. Benjamin de Rohan**, seigneur de, a French soldier, born in La Rochelle in 1583, died in London, Oct. 9, 1642. He was a son of René II. de Rohan by Catharine Parthenay, the heiress of the house of Soubise, and the brother of Henri de Rohan (1579-1638), the celebrated Huguenot leader. After serving in Holland under Maurice of Nassau he was appointed in 1621, by the Protestant assembly at La Rochelle, commander of Poitou, Brittany, and Anjou. When the other chiefs had laid down their arms, he boldly but unsuccessfully defended St. Jean d'Angély; and his attempts to renew the war during the winter of 1622, and his mission to England to obtain help from James I., were equally abortive. In 1625, after taking a royal squadron and keeping at bay for several weeks the united French and Dutch fleets, he was defeated by Duke Henry II. of Montmorency and driven from the islands of Ré and Oléron (Sept. 15), which he had occupied for some time. Having secured through the medium of Charles I. the hollow peace of April 6, 1626, he joined in 1627 the English in the fruitless attempt to relieve La Rochelle, and some time after the surrender of that stronghold he went to England, although permitted to remain in France. He was buried in Westminster abbey. **II. Charles de Rohan**, prince de, a French soldier, a descendant of the preceding, born in Paris, July 16, 1715, died there, July 4, 1787. He was notorious for his dissipation, and was a favorite of Louis XV. and his adjutant in Flanders, where he was appointed governor in 1748. In 1751 his governorship was extended over Hainaut. Through the influence of Mme. de Pompadour he became in 1753 allied to the royal family by the marriage of his daughter to the prince de Condé, who obtained for him a high command in the army of the Rhine (1756). He was surprised and routed at Gotha with 8,000 men by Seydlitz with 1,500 troops, and soon afterward he was ignominiously defeated by Frederick the Great at Rossbach (Nov. 5, 1757), where he commanded the united French and allied armies. Nevertheless he was appointed to other high commands and offices, and after varied successes and quarrels with fellow commanders, especially with the duke de Broglie, over whom he triumphed through his influence at court, his career in the army ended disastrously with his loss of Cassel, Nov. 1, 1761.

**SOULANGES**, a W. county of Quebec, Canada, on the N. bank of the St. Lawrence, above Montreal; area, 137 sq. m.; pop. in 1871, 10,808, of whom 9,724 were of French and 732 of Scotch origin. It is traversed by the Grand Trunk railway. Capital, Coteau Landing.

**SOULE, Joshua**, an American clergyman, born in Bristol, Me., Aug. 1, 1781, died in Nashville, Tenn., March 6, 1867. He was licensed to preach in 1798, joined the Methodist conference in 1799, was ordained in 1802, and in 1804 appointed presiding elder of the Maine district, which embraced 13 circuits and one station. In 1808, at the general conference in Baltimore, he drew up the plan of a delegated general conference which now appears in the "Discipline." After presiding over various

other districts in Maine and Massachusetts, he was elected in 1816 book agent and editor of the "Methodist Magazine." In 1820 he was stationed in the city of New York; in 1821 he was preacher in charge of the station in that city, and in 1822–'3 of the Baltimore city station. In 1824 he was elected bishop. He was delegate from the general conference to the British Wesleyan Methodist conference in 1842; and afterward he travelled extensively in the British islands and in France. On the division of the church, Bishop Soule adhered to the southern portion, and removed from Lebanon, O., to Nashville, Tenn. In 1853–'4 he made an episcopal tour in California.

**SOULÉ, Pierre,** an American statesman, born in Castillon, France, in 1801, died in New Orleans, March 16, 1870. He studied in the Jesuits' college at Toulouse, was implicated in a plot against the Bourbons, fled to a village in Navarre, and became a shepherd. He was afterward an advocate in Paris, and for an attack upon the ministry in the *Nain* newspaper he was fined 10,000 francs and sentenced to prison. He escaped to England, and in 1825 emigrated to New Orleans, where he rose to eminence at the bar. In 1847 he was elected United States senator from Louisiana to fill a vacancy, and in 1849 was reëlected for a full term. In 1853 he was appointed minister to Spain, where he fought a duel with M. Turgot, the French ambassador, and wounded him. He participated in the Ostend conference in 1854 (see BUCHANAN, JAMES), and came home in 1855. In 1861 he visited Europe as diplomatic agent of the confederate government, and in 1862 was arrested in New Orleans by Gen. Butler, and imprisoned, but was released on condition of leaving the country. He returned to New Orleans shortly before his death.

**SOULIÉ, Melchior Frédéric,** a French novelist, born at Foix, Dec. 23, 1800, died at Biévre, near Paris, Sept. 23, 1847. He was expelled from the law school in Paris on account of his radicalism, and after publishing in 1824 *Amours français*, an unsuccessful volume of poems, he supported himself as the foreman of an upholsterer till 1828, when his drama *Roméo et Juliette* proved successful at the Odéon. Most of his subsequent pieces failed, excepting *Clotilde* in 1832. He achieved greater celebrity as a novelist, especially by *Diane et Louise* (1836), which he dramatized under several titles. He published more than 150 volumes of novels, including *Le maître d'école* (1839), *Si jeunesse savait, si vieillesse pouvait* (1842), and his *Mémoires du diable* (1844), which had a prodigious circulation. His monument in Père Lachaise was unveiled Feb. 20, 1875.

**SOULOUQUE, Faustin,** a Haytian emperor under the title of Faustin I., born in the district of Petit Goave, in the southern peninsula of Hayti, about 1785, died there in July, 1867. He was born a slave, but became free by the decree of 1790, took part in the negro insurrection against the French in 1803, served as captain under President Boyer in 1820, as colonel under Hérard in 1844, as brigadier general under Guerrier in 1845, and was commander of a division at the time of the death of Riché in February, 1847. While the generals Souffran and Paul were disputing and plotting for the succession, the senate unexpectedly elected Soulouque to the presidency, March 1, 1847. He belonged to the party of the mulattoes, but, jealous of their power, he began to attach the blacks to his interest, and to pursue a system of terror toward the citizens, whom he decimated in 1848 by confiscations, proscriptions, and executions. Like his predecessors he vainly sought to subjugate the republic of Dominica. In 1849 he caused the restoration of monarchy, ostensibly by the will of the people and the action of the chambers, was almost unanimously chosen emperor (Aug. 26), assumed the title of Faustin I., surrounded himself with a numerous court, founded a military and civil order and an order of nobility, and issued a constitution, reserving to himself the right at any juncture to rule as he pleased. He was crowned in 1850, and a second time, with greater pomp, on April 18, 1852. In 1855 he repeated his attempt to conquer the neighboring republic, and took the field with a considerable army, but was so completely defeated by a few hundred Dominicans under Santana that he barely escaped capture, and his treasure and throne fell into the hands of the enemy. A campaign in the following year also terminated in his defeat. A commercial crisis in 1858 increased the general discontent, and Gen. Geffrard led a revolt, and was recognized as president of the republic of Hayti. Soulouque was, however, allowed to depart (Jan. 15, 1859) with his wife and child for Jamaica. After the fall of Geffrard in 1867, he returned to Hayti.

**SOULT, Nicolas Jean de Dieu,** duke of Dalmatia, a French soldier, born at St. Amans-la-Bastide, Guienne, March 29, 1769, died there, Nov. 26, 1851. He enlisted in 1785, became a captain in 1793, and reached in one year the rank of brigadier general after the battle of Fleurus (June 26, 1794). In 1799 he was made general of division by Masséna, with whom he distinguished himself at the battle of Zürich, Sept. 25, which saved France from invasion, and at the siege of Genoa, during which he was surrounded and captured by the Austrians, May 15, 1800, but was speedily exchanged, after the battle of Marengo. In 1804 Napoleon made him a marshal. In 1805 he increased his reputation at the head of the fourth corps in Germany, especially at Austerlitz, Dec. 2, where Napoleon declared him to be the first strategist of Europe. In 1806–'7 he won additional fame in the campaign against Prussia, and finally occupied Königsberg (June 16, 1807), and after the treaty of Tilsit he was made governor of Berlin and duke of Dalmatia. Next appointed commander of the second corps in Spain, he nearly annihilated the Spanish army at Burgos,

Nov. 10, 1808, took from the English Corunna (where he had been at first defeated) and Ferrol, and occupied Oporto and the northern part of Portugal, whence he was expelled by Wellington. After his retreat to Spain he gained several advantages, and on March 11, 1811, he obtained possession of Badajoz through the treachery of the Spanish commander; but he was defeated by Beresford at Albuera, May 16, and Wellington carried Badajoz by assault with fearful loss on the night of April 6, 1812. Disapproving of King Joseph's proceedings, Soult asked to be relieved; but soon after reaching France Napoleon ordered him to assume the chief command of the army in Spain, and retrieve Joseph's crushing defeat at Vitoria, June 21, 1813. But despite his wonderful efforts, after various engagements in the mountain passes with the main body of the allies, he was cut off from Bayonne by Wellington, defeated at Orthez, Feb. 27, 1814, and forced back to Toulouse, which was taken by Wellington, April 10. Soult offered a heroic resistance, and consented only to an honorable capitulation after the full confirmation of Napoleon's first abdication, and led his troops safely out of the city. His conduct during this memorable campaign received the warm commendation of Napier, the English historian of the peninsular war; and when 26 years later Soult officially attended the coronation of Queen Victoria, he was most cordially received by Wellington and his other former adversaries. Under the first restoration he was for a short time minister of war; but as he rejoined Napoleon on his return from Elba, and served as major general at Waterloo, he was banished from 1816 to 1819. In 1820 he was reinstated as a marshal and received a pension of 200,000 francs, and in 1827 he became a peer. Under Louis Philippe he was minister of war in 1830–'31, prime minister in 1832–'4, and again (with the portfolio of foreign affairs in 1839–'40, and of war in 1840–'45) from 1839 till 1847, when the extraordinary title of marshal-general was given to him on his retirement. He left memoirs, of which only the first part was published (3 vols., 1854) by his son Napoléon Hector, who died in 1857.

**SOUND**, the sensation peculiar to the organ of hearing. This sensation is the final effect of a closely connected series of mechanical actions, which have their origin in some rapidly vibrating body, whence they are propagated progressively through the air to the membrane of the drum of the ear, and thence, through a series of small articulated bones, into the inner cavity. This cavity, tunnelled in the hard petrous bone, is filled with liquid and contains the delicate terminal fibrils of the auditory nerve. Each of these fibrils appears to be attached to the centre of a delicate rod or chord. These chords are stretched, and being of different lengths and diameters are generally supposed to be tuned to sounds extending through a range of several octaves. By the sympathetic vibrations of these tuned bodies they shake their attached nerve fibrils and thus give rise to sensations peculiar to sounds of various pitch. From the foregoing we see that the subject of sound is naturally divided into three parts. In the first division we shall consider the manner of production of sound, and the nature of those vibrations which cause sonorous sensations. In the second part we shall explain the manner in which these vibrations are propagated through the elastic medium existing between the vibrating body and the ear. In the third part we shall consider the manner in which the ear perceives a simple sound and analyzes a composite sound into its elementary sonorous sensations.—At the place of origin of every sound there is always some solid, liquid, or gaseous body in a state of rapid vibration. This vibrating body imparts its motions to any elastic medium with which it may be in contact, and the vibrations thus given to the contiguous medium are propagated in all directions. The contiguous elastic medium may be a solid, a liquid, or a gas. Proofs of the above statements are readily afforded by the following simple experiments. A sounding tuning fork is drawn over a piece of smoked glass, so that the point of a piece of foil, attached to one of its prongs, may just touch the glass. After this experiment we observe that the point attached to the fork has laid bare the glass in a sinuous line, as seen in fig. 1, thus showing that when the fork causes

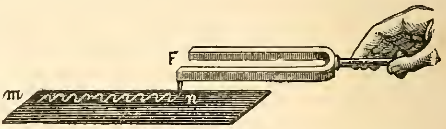



Fig. 1.

a sound its prongs are swinging to and fro in a direction perpendicular to its length. That a liquid may be the vibrating body at the source of the sound, is shown by placing a "siren" under water and forcing through it a current of water. If we take an organ pipe with glass sides and sprinkle in its interior a small portion of precipitated silica, we shall, on sounding the pipe, observe this very light powder rise in thin delicate vertical plates in certain portions of the pipe, while in intermediate places the silica remains at rest. Neither the tone of the pipe nor the positions of the plates of silica are altered in the least by pressure on the walls of the pipe; thus showing that the real vibrating body in an organ pipe is its contained column of air. It now remains to show that the medium through which the sonorous vibrations are propagated outward from the vibrating body may be either solid, liquid, or gaseous. One of the most beautiful experiments in acoustics was invented by Sir Charles Wheatstone, and shows that sounds, even the most complex, may be transmitted through solids as readily as through the air. In the lower

room of a house, or in a tightly closed box lined with felt, he placed a musical box. On the top of the musical box rests the end of a long light wooden rod which reaches to one of the rooms above. The rod is insulated from the floor of the rooms by India rubber. No sound is perceived in the upper room until we place on the top of the rod a violin, a guitar, or any instrument with a sounding board, when the sounds of the musical box fill the upper room and appear to emanate from the musical instrument on the rod. That a liquid may be the medium for the transmission of sonorous vibrations is readily proved by placing on a resonant box a long cylindrical vessel filled with water, and then bringing in contact with the surface of the water a disk of wood attached to the foot of a vibrating tuning fork. The vibrations of this instrument are sent through the water, and reaching the top of the resonant box throw the latter into vibrations of the same period as those of the fork. That the air, a gaseous body, vibrates while it is transmitting sonorous pulses, can be shown by placing in the path of these vibrations a delicate membrane strewn with a light dry powder. The powder dances on the membrane while the sound is perceived. The vibrations of the air can also be detected by means of the so-called "sensitive flames," which are formed of jets of gas, issuing from cylindrical orifices under such great pressure that they are just on the point of flaring, or roaring. These flames are so sensitive to aërial vibrations that the slightest sound, if of the proper pitch, will cause them suddenly to contract greatly in their lengths, and at the same time to give forth roaring sounds. These flames are generally most sensitive to acute sounds, such as a hiss or the jingling of a bunch of keys. (See PYROPHONE.)—An analysis of sonorous sensations reduces them to three kinds: pitch, intensity, and timbre. 1. *Pitch and the Determination of the Number of Vibrations of a Sounding Body.* Pitch is that quality of sound by which we distinguish the position of sounds in the musical scale. One sound is thus said to be higher or lower than another. Pitch depends on the number of vibrations in a second which enter the ear. The pitch rises with the increase of the number of vibrations. In England, Germany, and America a vibration is understood to be a motion to and fro, while in France it is a motion to or fro. The sound having the lowest pitch is caused by 40 vibrations in a second; a smaller number of vibrations than this does not cause a continuous sonorous sensation. The highest audible sound is caused by about 40,000 vibrations in a second; vibrations of greater frequency than this are not generally audible, though the limit of audibility of the highest sounds is different for different persons. Thus some cannot hear the chirrup of the cricket, while others perceive sounds one or two octaves above it. Dr. Wollaston discovered this variation. The pitch of a sound may be determined by several methods, some of the most precise of which are: 1. By means of an instrument called a "siren," fig. 2, invented by Cagniard de Latour. It consists of a metal cylinder the bottom of which is perforated by a tube through which air is blown into the cylinder. The top of the cylinder is perforated with a number of holes. Just over this top and nearly touching it rotates a metallic disk on a vertical axis. This disk is perforated with the same number of holes as are in the cylinder. The form of the holes is shown in the section in the figure. They do not pass perpendicularly through the plates, but

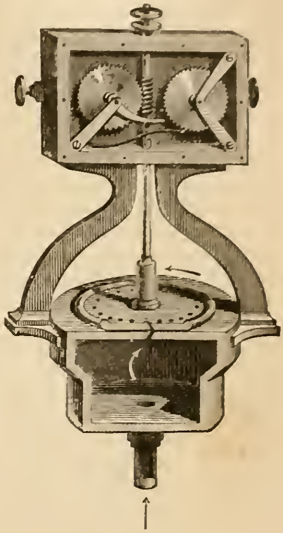


FIG. 2.

slope contrary ways, so that the air when forced through the holes in the top of the cylinder impinges upon one side of the holes in the rotating plate, and thus blows it round in a definite direction. The disk in making one revolution opens and shuts the holes as many times as there are holes in the disk and cylinder, and hence the wind escapes from the cylinder in successive puffs, the frequency of which depends upon the rate of rotation. A sound is thus produced having a pitch which rises with the increase of velocity of rotation. The vertical axis has a screw cut on it which works in a notched wheel attached to a dial, which shows the number of rotations of the disk. To determine the pitch of a sound by means of this instrument, we gradually increase the rotation of the disk until the sound emitted approaches the pitch of the sound the number of vibrations of which we would determine. When the two sounds are quite near in pitch, the ear will perceive distinct beats produced by the joint action of the two sounds on the air. The velocity is now cautiously increased until the beats disappear. At this moment the counter is put in operation, and the disk is allowed to run for a known number of seconds; then the counter is thrown out of action and the number of revolutions of the disk read off. On multiplying the number of revolutions of the disk by the number of its holes, and dividing this product by the number of seconds during

which the disk was connected with the counter, we have the number of vibrations per second corresponding to the given sound. 2. The number of vibrations per second of a tuning fork, or of any rod or plate, can be determined very precisely by the following plan. The tuning fork or rod has attached to it a piece of delicate foil, which just touches the smoked surface of paper covering a metallic cylinder. If the cylinder is turned while the fork vibrates, it is evident that the point attached to the fork will trace a sinuous line on the cylinder. Now, if by any means we can mark off seconds of time on this sinuous trace, we shall have only to count the number of sinuosities between two successive second marks to have the number of swings made by the fork in a second. The above conditions are attained in the following manner: A break-circuit clock is placed in the primary or battery circuit of an induction coil; one of the terminal wires of the secondary circuit of this induction coil is connected with the tuning fork, while the other terminal wire is connected with the revolving cylinder. At each second the break-circuit clock sends a spark from the point attached to the vibrating point, through the smoked paper, to the revolving metallic cylinder. It is evident that on counting the number of flexures contained between two successive spark holes in the fork's trace we have the number of half vibrations made by the fork in a second. When we have thus determined the exact number of vibrations, at a known temperature, given by a tuning fork, we may use the number of vibrations of this fork as a point of departure in determining the number of vibrations of any rod, plate, chord, or membrane, by means of a very simple and ingenious method recently devised by Prof. O. N. Rood, and described by him in the "American Journal of Science," August, 1874. Let us suppose that it is required to ascertain whether two tuning forks are in unison, or to determine the difference in the number of vibrations executed by them in a second. For this purpose a short piece of fine steel wire is attached to each of the forks, and they are supported in positions so that their vibrations shall be at right angles to each other, as indicated in fig. 3. The wires may have a diameter of one or two tenths of a millimetre, or even less, and are to be attached with the least possible amount of soft wax or varnish. They may be brought quite near to each other, or may if necessary be several inches apart. If the forks are now set into vibration and the intersection of the wires viewed against a bright background with a small telescope, it will be seen that an optical figure is developed, which is partly due to the same well known conditions that give rise to the acoustic figures of Lissajous, and partly to the circumstance

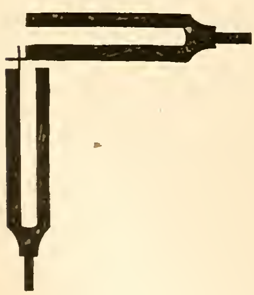


Fig. 3.

Fig. 4.

Fig. 5.

that the wires move with less velocity when near their maximum deviation from the line of rest. Hence, if the difference in phase is zero, an appearance like fig. 4 is produced, which changes into fig. 5 when the difference in phase has increased to one half a complete vibration. Fainter indications of the same figures are shown in all cases, except when the difference in phase is one fourth, three fourths, &c., of a vibration, or nearly so. This figure is characteristic then of forks in unison, and the fact of its constancy will be the evidence of perfect unison. If the forks are not exactly in unison, fig. 4 will after some time change into fig. 5, and the number of seconds necessary for this change will measure the interval required by one of the forks in gaining or losing half of a complete vibration. The focal length of the object glass of the telescope used was 120 millimetres for parallel rays, and when the aperture was reduced to two millimetres, sufficiently distinct vision of both wires could be obtained, even when their distance apart was several centimetres. With this limited aperture, the light from a white cloud answered quite well. If the forks differ by an octave, an almost equally distinct and well marked figure will be produced, such as is seen in figs. 6 and 7, which represent the characteristic appearances in this case. This figure is quite as useful for purposes of investigation as for that of unison. Somewhat less distinct and more complicated figures are given by the quint, the duodecime, and the double octave. From the foregoing it is evidently easy with this method to bring a vibrating string into

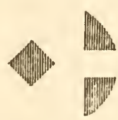


Fig. 6.

Fig. 7.

unison with a given tuning fork, or to adjust it so that the interval shall be a quint, octave, twelfth, or double octave, above or below. It is also easy to ascertain the number of vibrations made by a string in a given case, by the aid of a bridge and a properly selected fork making a known number of vibrations, the string being shortened till it furnishes one of the above mentioned figures, and therefore

executes a known number of vibrations, after which the number of vibrations made by its whole length can readily be calculated by a well known law. 3. The following method of determining the number of vibrations of a sounding body is applicable to all cases, whether the body be solid, liquid, or gaseous. After we have determined, by the method already described, the precise number of vibrations of a given fork, we make another fork higher in pitch than the former, which makes with the first eight beats a second; a third fork is then tuned until it gives eight beats with the second fork, or sixteen with the first. Thus a series containing many forks is formed, any fork of which makes eight vibrations more in a second than the fork next below it in pitch. On each fork is stamped its number of vibrations. To determine with these forks the pitch of a given sound, we find in the series of forks one which makes with this sound eight beats or fewer than eight beats in a second, and we count the number of these beats given during one minute or more. Dividing the number of beats found by the number of seconds during which the observation lasted, we have the number of beats made in one second by the fork and the given sound, and as the number of beats per second is always equal to the difference in the number of vibrations per second of the two sounds, it follows that we at once know how many vibrations per second the fork exceeds or falls short of those of the sound. To ascertain whether the fork makes more or less than the sound in a second, we place a small piece of wax on a prong of the fork, and observe whether this causes the number of beats to increase or to diminish. If the number of beats increases, then the fork was lower in pitch than the sound, while if the beats are less frequent the fork was higher in pitch than the given sound. The series of forks just described is called after its inventor a Scheibler's tonometer. 2. *The Intensity of Sound.* The intensity of sound depends on the energy of the aërial vibrations contiguous to the ear. For sounds of the same pitch the intensity varies as the square of the amplitude of the aërial oscillations. The plans generally used are unworthy the designation of measures, being only rough comparisons. The writer first succeeded in measuring the relative intensities of sounds of the same pitch, and the reader is referred to the publication on the subject in the "American Journal of Science" for February, 1873. The principle of the method depends on the fact that if two sonorous impulses meet in traversing an elastic medium, and if at their place of meeting the molecules of the medium remain at rest, then at this place of quiescence the two impulses must have opposite phases of vibration and be of equal intensities. By means of an appropriate apparatus the above conditions are brought about in the union of the two sounds whose intensities we would compare. We then measure the distances from the place of meeting of the two sounds to the points of origin of these sounds. The relative intensities of the sounds will be as the inverse ratio of the squares of these distances. But to determine the relative or absolute intensities of sounds of different pitch is one of the most difficult of experimental problems. The writer has recently succeeded in reaching approximate measures of the absolute intensities of sounds by measuring the amounts of heat produced when the sound vibrations are absorbed by India rubber. By knowing the exact fraction of the whole energy of the sound absorbed and the specific heat of the rubber, the mechanical equivalent of the entire sonorous vibrations, in fractions of a Joule's unit, can be calculated. It was thus shown that the aërial vibrations produced by a treble C fork, mounted on its resonant box and vibrated during ten seconds, will, if entirely converted into heat, raise the temperature of one pound of water $\frac{1}{100,000}$ of a degree; or, in mechanical effect, will raise 54 grains one foot high. 3. *Timbre of Sound, and Analysis of Sounds.* Timbre is a term used to designate those special characters by which we distinguish between two or more sounds having the same pitch and equal intensities. Thus, sounding the same note on a flute, a violin, a clarinet, and a piano, the ear at once distinguishes the instrument producing the note. Some preliminary knowledge as to the differences between a simple and a composite sound is necessary before giving an explanation of the cause of timbre. A simple sound is a sound which has only one pitch. Such a sound is produced when a tuning fork, mounted on a resonant box, is gently vibrated by drawing a bow across one of its prongs. All simple sounds are alike in timbre; the only differences existing between them are differences of pitch and of intensity. Thus, if simple sounds alike in pitch and in intensity were produced by four instruments differing even very much in construction, the ear could not give us the information by which we could distinguish one instrument from another. On examining closely into the nature of the aërial vibrations which produce a simple sonorous sensation, we find that this sensation is only experienced when the aërial particles swing to and fro with the same character of reciprocating motion as pertains to a freely swinging pendulum. But there are other sounds which are not simple but composite, being formed of the combination of several simple sounds of various pitch and intensities. Thus, by attentive listening one can distinguish several sounds of various pitch in the sound of a piano string, or in that of a reed organ pipe. On analyzing these composite sounds, by methods presently to be described, we find that they can always be separated into two or more simple sounds, and that if we call the number of vibrations producing the lowest in pitch unity, then the remaining sounds will, in order of ascending pitch, bear to the first the vibration ratios of

1 : 2, 1 : 3, 1 : 4, 1 : 5, &c. The lowest sound perceived is generally the most intense, and is called the "fundamental." This is the sound which is indicated in musical notation, and which designates the pitch of the composite sound. But really when we produce one of the sounds indicated by musical notation, we generally at the same time evolve a long series of sounds bearing to each other the vibration relations of 1, 2, 3, 4, 5, 6, &c. This series of sounds is called the harmonic series, and is sometimes designated as the series of overtones of the fundamental sound. But the members of this series do not always all coexist; thus the sounds of the clarinet only contain the odd numbers of the series, viz., 1, 3, 5, 7, &c. It is evident from the above facts that an indefinite number of different composite sounds can be formed by combining simple sounds and giving to them various relative intensities; and that each of these composite sounds will be characterized by its own peculiar timbre. This great discovery, that all simple sounds have one and the same timbre, and that the characteristic timbre of any other sound is due alone to the number and relative intensities of the harmonics or overtones forming the sound, was made by Helmholtz; he not only succeeded first in proving this by the experimental analysis of various composite sounds, but also by reproducing these composite sounds with their characteristic timbres by simultaneously sounding their simple sonorous components with their proper relative intensities. This explanation of timbre, as Helmholtz has shown, has a dynamic basis, and is the direct consequence of the celebrated theorem of Fourier, which may thus be rendered in the language of dynamics: Every periodic vibratory motion can always, and always in one manner, be regarded as the sum of a certain number of pendulum vibrations.—There are various methods of analyzing a composite sound. They are generally founded on the fact that if we have two bodies which give exactly the same number of vibrations in a second, and vibrate one of them, the other, although somewhat distant from the first, will be thrown into vibration by the action of the aërial pulses which have emanated from the first body. This must necessarily follow, for the pulses which the second body receives from the air synchronize with the number of vibrations in a second which this body alone can give. This phenomenon may be called "co-vibration." Helmholtz in his investigations generally used as co-vibrating bodies masses of air contained in hollow spheres of various sizes. These spheres are called resonators, and one of them, as made by König of Paris, is shown in fig. 8. These spherical masses of air are so graduated in volume that a series of resonators is formed, and each resonator will resound only to the number of vibrations in a second which is stamped on it. The manner of using these resonators is as follows: The compound sound falls upon the open mouth of the resonator, while the nipple-shaped tube opposite the mouth is placed in one ear, and the other ear is closely stopped with beeswax. If the sound, to which the

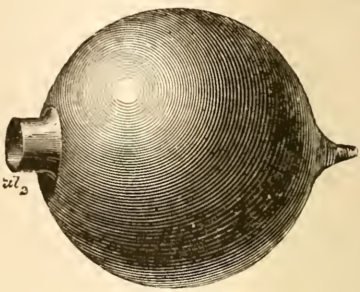


FIG. 8.

mass of air contained in this resonator enters into co-vibration, exists in the composite sound, then the ear will perceive this sound with some intensity, to the exclusion of the other component sounds. Thus by placing to the ear each resonator of the series and noting those which resound, we can readily ascertain the simple sounds, whose union forms the composite sound which we have analyzed. The writer has often replaced the resonators applied to the ear by tuning forks mounted on resonant boxes. If the mouth of one of these boxes, like fig. 9, be placed near a sounding reed pipe, and if the note of the fork on the resonant box exists in the composite sound of the reed, then this fork will be set in vibration and will continue to vibrate after the reed has ceased to sound; for the mass of air in the box acts like a resonator, and is set in vibration by the pulses of that harmonic of the reed which is in unison with it. But, as the fork is also in unison with the mass of air in the resonant box, it follows that it also is set in motion by the latter, so that, after the composite sound ceases, we find that the fork sings out alone, and thus shows that it has selected from a chorus of harmonics that one

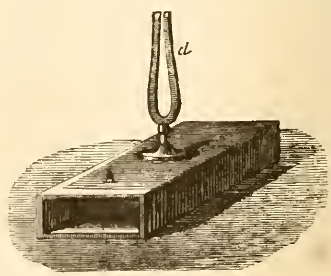


FIG. 9.

which is in unison with its own tone. It has thus been easy, by using one fork after another of the harmonic series of the reed, to show the composition of its sound to a

large audience. We have also succeeded with the following experiment. Forcibly sound the reed pipe and place around its mouth eight or more forks of the harmonic series of the sound given by the reed, with the mouths of their resonant boxes toward the reed pipe. After the reed has sounded for a few seconds, stop it, and we shall find that all of the forks are in vibration; and thus singing together, they approximately reproduce the sound of the reed. This experiment requires the resonant boxes, the forks, and the harmonics of the reed to be in exquisite unison. The reader may convince himself of the composite nature of the sound given by a piano string, by the following simple experiments. If we sound on the piano the C below the middle or treble C, if we call this note $C_2$, the harmonics of this sound will be $C_3$, $G_3$, $C_4$, $E_4$, $G_4$, $B\flat_4$, $C_5$, &c. But the seventh harmonic, or $B\flat_4$, is wanting, because the hammers of the piano strike the strings at points about one seventh of their length, and hence this harmonic cannot appear. If it did, it would cause harshness of timbre, for the seventh harmonic forms dissonant combinations with the other harmonics of the series. To show that all of the remaining harmonics exist in the sound of $C_2$, depress slowly and firmly the key of $C_3$; the hammer will rise, press against the string, and fall from it, but the damper of this string will remain raised. Now strike strongly the key of $C_2$, and after holding it for a few seconds stop its sound. We shall now hear the sound of $C_3$ very distinctly, showing that it has been set into vibration by the vibrations of $C_3$ which exist in the compound sound designated as $C_2$. In like manner one can show that $G_3$, $C_4$, $E_4$, $G_4$, $C_5$, &c., exist as components of the composite sound of the string of $C_2$. The reader who desires further information on the subject of sonorous analysis will find descriptions of six experimental methods in "Researches in Acoustics," paper No. 5, "American Journal of Science" for August and September, 1874. —*Reproduction of Sonorous Vibrations from the Curves made by Vibrating Bodies.* Experiment has established that the sensation of a simple sound is alone produced when the aërial molecules vibrate with the same reciprocating motion as pertains to a freely swinging pendulum. If we obtain the sinuous trace of a vibrating tuning fork or of a long elastic rod on a plate of smoked glass, fig. 10, we shall find, on making measures on these curves, that they are sinusoids or curves of sines, and hence can alone be produced by pendulum motions. But the curve produced by the fork can be made to reproduce the motions of the fork, only much slower, in the following manner: Cut a fine slit in a piece of paper, and slide it over the curve from right to left, as shown in fig. 10; then we shall see the portion of the curve exposed in the slit vibrating upward and downward with the same kind of motion as rules the oscillations of a pendulum. The aërial molecules and a point on the membrane of the drum of the ear vibrate thus when we experience the sensation of a simple sound. The majority

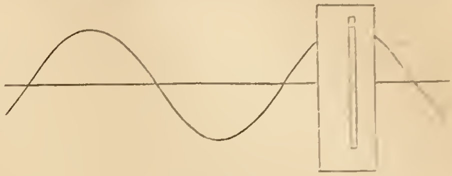


FIG. 10.

of sounds, however, are composite. It is evident that a molecule of air or a point on the tympanic membrane can have only one direction of motion at one and the same instant, and therefore that a composite sonorous vibration will give to the molecule of air a motion which must be the resultant of the combined motions of all the pendulum motions of its simple sonorous components. Hence we may suppose a molecule of air, animated with a resultant motion like the above, to trace a curve which evidently will be the resultant of all the simple sinusoidal curves belonging to the sonorous elements of the composite sonorous vibration. We can obtain this resultant curve as follows, and then we can reproduce from it the motions of a molecule of air, or of a point on the tympanic membrane, when these points are acted on by a compound sonorous vibration. Draw on the axis *a b*, fig. 11, sinusoidal curves having lengths related to each other as 1 : 2 : 3 : 4 : 5 : 6. These curves will then be the separate traces of the first six harmonics contained in a composite vibration which causes a musical sound, such as the sound of a piano string. Another axis *c d* is now drawn below *a b*, and 500 equidistant lines, perpendicular to *a b* and *c d*, are drawn through the curves on *a b* and extended below the line

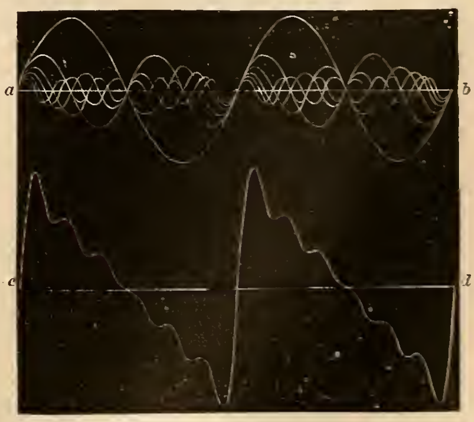



FIG. 11.

*c d*. The algebraic sums of the ordinates of the curves on *a b* are now transferred to the corresponding ordinates on *c d*, and through

points thus found is drawn the curve having the line $c\,d$ for its axis. This curve may be regarded as the trace of the composite vibration of a molecule of air, or of a point of the tympanic membrane, on a surface which moves near these points. Hence if we slide this curve along, in the direction of its axis, under a slit in a screen which allows only one point of the curve to appear at once, we shall reproduce in this slit the vibratory motion of the aërial molecule and of the point on the tympanic membrane. The writer has exhibited this motion in a continuous, or rather recurring manner, as follows: On a piece of Bristol board he drew a circle, and in one quadrant of this circle he drew 500 equidistant radii. On these radii, as ordinates, he transferred the corresponding values of the same ordinates of the resultant curve of fig. 11, diminished to one fourth of their lengths. He thus deflected the axis of the curve of fig. 11 into one fourth of a circle curve; and this, repeated four times on

FIG. 12.

the Bristol board, rendered the curve continuous and four times recurring, as shown in fig. 12. He now cut this figure out of the board and used it as a template. He placed the latter centred on a glass disk 20 in. in diameter. This disk was coated on one side with opaque black varnish, and with the template and the separated points of a pair of spring dividers he removed from the glass disk a sinuous band, as shown in fig. 12. The glass disk was now mounted on a horizontal axis and placed in front of a lantern, the diameter of whose condensing lens was somewhat greater than the amplitude of the curve. The image of that portion of the curve which was in front of the condenser was now projected on a screen, and then a piece of cardboard having a narrow slit cut in it was placed close to the disk, in the direction of one of its radii. On revolving the disk he reproduced on the screen the vibratory motion of a molecule of air, or of a point on the tympanic membrane, when these are acted on by the joint impulses of the first six harmonic or pendulum vibrations, forming a musical sound. On slowly rotating the disk one can readily follow the compound vibratory motion of the spot of light; but on a rapid revolution of the disk, persistence of visual impressions causes the vibrating spot to appear elongated into a band. This band is not equally illuminated; it has six distinct bright spots in it, beautifully revealing the six inflections in the curve. By sticking a pin in the centre of fig. 12, as an axis about which revolves a piece of paper having a fine slit, the reader can gain some idea of the complex motion we have described. Of course it is understood that in the above experiment the amplitudes of the vibrations are enormously magnified when compared with the wave lengths, and that it is really only when the amplitudes of the elementary pendulum vibrations are infinitely small that the resultant curves we have given can be rigorously taken as representing what they purport to; for the law of "the superposition of displacements" depends on the condition that the force with which a molecule returns to its position of equilibrium is directly proportional to the amount of displacement, and this condition only exists in the case of infinitely small displacements; yet the law holds good for the majority of the phenomena of sound. It is also to be remarked that in order to simplify the

FIG. 13.—Resultant Curve formed by combining the curve of a musical note with that of its octave. $\lambda : \lambda' :: 1 : \frac{1}{2}$.

consideration of the curves, they are all represented with the same phase of initial vibration. Of course the resultants have an infinite

FIG. 14.—Resultant Curve formed by combining the curve of a musical note with that of its fifth. $\lambda : \lambda' :: 1 : \frac{2}{3}$.

variety of form, depending on the differences in their initial phases, and on the amplitude of the harmonic elements. In figs. 13, 14, and

15, we have drawn the resultant curves formed by combining the curves of musical sounds corresponding to the various consonant intervals indicated below the figures. As these

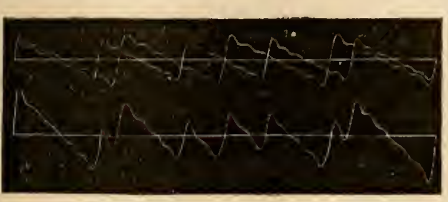


FIG. 15.—Resultant Curve formed by combining the curve of a musical note with that of its major third. $\lambda : \lambda :: 1 : \frac{4}{5}$.

curves are the resultants formed by the combination of the curves of composite musical sounds, it follows that the components of these curves are not simple sinusoidal curves, as in the case of fig. 11, but are derived from the resultant of fig. 11 by reducing to one fourth the amplitude of that curve, and by taking wave lengths corresponding to intervals indicated below the figures. From the curves of figs. 13, 14, and 15 can be reproduced their generating motions in the same manner as we have done in the case of the curve of fig. 11. As a periodic or recurring vibration can alone produce in the ear the sensation of sound, and as the duration of the period is always equal to the least common multiple of the periods of the pendulum vibrations of the components, it follows that in the case of a sound formed of a harmonic series the period equals the time of one vibration of the fundamental; but in the cases of other combinations the duration of the period increases with the complexity of the ratio of the times of vibration of the components; thus, the durations of the periods of the following combinations are placed after them in fractions of a second: $C_3+C_4=\frac{1}{256}$; $C_3+G_3=\frac{1}{128}$; $C_3+E_3=\frac{1}{64}$; $C_3+E_3+G_3=\frac{1}{25.6}$; $C_3+E_3+G_3+C_4=\frac{1}{17}$ of a second. ($C_3$ stands for the treble C; $C_4$ is the C of the octave above it.)—*Transmission of Sound.* If air were incompressible, a motion produced at any point of its mass would instantaneously be transmitted to every other point of the atmosphere. Thus, if we imagine a long tube, open at one end and closed at the other by a piston which moves in the tube without friction, it is evident that if this piston were pushed into the tube a certain distance, the air would at the same time move out of the tube at the open end. But air is compressible and elastic, and after the piston has been pushed into the cylinder, a measurable interval of time will have elapsed before the air moves out of the open end of the tube. This interval is the time taken by sound to traverse the length of the tube. The velocity of sound is 1,090 ft. in a second at 32° F., and it increases almost exactly one foot in velocity for each degree of elevation of temperature above 32°. Now imagine the piston to move forward into the tube over a minute fraction of an inch, and that it occupied $\frac{1}{10}$ of a second in making this forward motion; then the length of air compressed at the instant the piston has come to rest will be equal to $\frac{1090}{10}$, or 109 ft. If the piston makes its movement in $\frac{1}{100}$ and in $\frac{1}{1000}$ of a second, the length of air compressed in the tube will be respectively 10·9 and 1·09 ft. But such a compressed portion of air cannot remain at rest, by reason of its elasticity. It immediately expands, and in so doing presses forward on the undisturbed air in front of it and on the interior wall of the tube. The column of compressed air in thus regaining its natural density has compressed an air column of equal depth in front of it; this in its turn reacts on the back column and prevents it from rarefying, while at the same time it has compressed another column of equal depth in front of it, and so on. Thus the sonorous pulse, as it is called, is transmitted through the whole length of the tube. A beautiful illustration of the manner in which a sound pulse is propagated is afforded by attaching to a sounding board a long, elastic spiral spring of brass, while the other end is held in the hand. On separating two of the coils of the spring with a finger nail, and then allowing them suddenly to come together, a pulse or compression will be thrown through the whole length of the spring to its further end, where striking on the sounding board it will cause a sharp rap. This action against the board will be reflected from the board to the hand, and again from the hand to the board, and so on several times in succession. When the piston above spoken of makes a backward movement, it creates a vacant space in the tube, into which the air rushes by virtue of its elasticity, and thus a certain depth of air is rarefied; this first cylinder of rarefied air in retracting to its natural dimensions causes rarefaction in an equal depth of air in front of it; this second rarefied cylinder of air now reacts on the first, brings it to rest, and causes rarefaction in a third equal column of air, and so on. Thus the rarefaction, like the compression, is transmitted through the whole length of the tube. When a compression traverses the tube it successively brings the molecules of air nearer together, while a rarefaction in its progress separates the aërial molecules; hence, if we imagine the piston to move backward and forward with a regular vibratory motion we have rarefaction succeeding compression in regular order, and the effect on any one molecule of air is to give it a like regular motion backward and forward. In the above discussion we have, for simplicity, supposed the piston to have a uniform velocity during its motions; but this, as we have already seen, is not the case with freely vibrating elastic bodies, for they have the same character of reciprocating motion as that of a freely swinging pendulum. To explain what will be the effect on the air of such a motion, we will suppose that the piston vibrates through a

very small distance, $a\,a'$, fig. 16, making equal excursions on one side and the other of the position of equilibrium $m\,m'$; and as the piston vibrates like a pendulum, it will increase

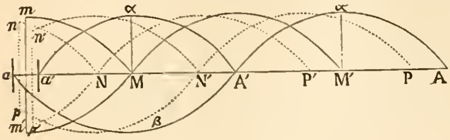



FIG. 16.

in velocity as it goes from $a$ or from $a'$ to $m\,m'$, and diminish in velocity as it goes from $m\,m'$ to $a$ or to $a'$. Let T be the time taken by the piston to make a semi-vibration, that is to say, a motion from $a$ to $a'$ or from $a'$ to $a$. Divide this time T into exceedingly small and equal parts $t$, during which the piston will also go over very small but unequal spaces, increasing with the velocity from $a$ to $m\,m'$, and diminishing with the velocity as the piston goes from $m\,m'$ to $a'$. The first very small displacement of the piston, accomplished during the time $t$, will produce in a very thin layer of air, which touches the piston, a very feeble degree of compression, and this compression will progress forward into the air of the tube. The very small succeeding motion of the piston during the next succeeding $t$ will produce a slightly greater condensation, which will travel behind the former condensation with the same velocity. The third displacement of the piston will produce a still greater condensation, and so on, until the displacement which brings the piston to the position $m\,m'$, which, being the greatest of all, will produce the greatest condensation. If the piston continues its motion to $a'$, with a velocity which is now gradually decreasing, a new series of condensations will take place, less and less in degree, which will travel behind those of the first series. These two series will be symmetrically placed on one side and the other of the maximum condensation, if we suppose that the two semi-oscillations of the piston are equal, and if we neglect the very small amplitude of oscillation $a\,a'$. If $a$ A' is the space through which the first condensation progresses in the time T, then all the condensations which have succeeded it during the movement of the piston from $a$ to $a'$ will be distributed in the space $a'$ A'. If we represent by ordinates these condensations at the moment when, the piston having arrived at $a'$, the first condensation is at A', we will form a curve $a'$ $a$ A', whose maximum ordinate M $a$ will represent the condensation produced by the piston at the moment of its passage through $m\,m'$. Let us now suppose that the vibrating piston returns on its path, it will produce by this motion a series of increasing dilatations during the time $\frac{1}{2}$T, and then decreasing dilatations until the instant when the piston reaches $a$. These dilatations will travel behind the condensations, and when the piston has returned to $a$, in which case the series of condensations will have reached the position A' $a$ A, these dilatations will be distributed in the space $a$ A', and the diminution of density of the layers of air can be represented by the negative ordinates of the curve $a\ \beta$ A', below the axis of the curve $a$ A'. The state of air in the tube at the instant when the vibrating piston, departing from $a$, arrives at $n\,p$, $m\,m'$, $n'\,p'$, $a'$, is indicated by the curves $n$ N, $m$ M, $n'$ N', $a'$ A'. If the piston makes another complete vibration from $a$ to $a'$ and from $a'$ to $a$, a new series of condensations and of dilatations, distributed in a space equal to $a$ A, will travel behind the first series already described. The dilatation and condensation contained in $a'$ A, and produced by a complete vibration of the body at the origin of sound, *i. e.*, by an oscillating motion from $a$ to $a'$ and back from $a'$ to $a$, is called a sonorous wave. A sonorous wave is always formed of two parts, one half of air in a state of condensation, the other half of rarefied air. The sum of all the condensations in the condensed half of the wave is represented by the area of the curve $a'$ $a$ A'; and if we divide this by the interval T of a half vibration of the body, we have the mean condensation of the half wave. This mean condensation can be calculated, and it has been found that for the sound given by 250 vibrations per second, which corresponds nearly with the lowest C of the violin, this compression gives for the compressed half of the wave an increase of $\frac{1}{1710}$ to the ordinary density of the atmosphere. The length of a wave is evidently the distance through which the air has been affected the moment after the first complete vibration of the sonorous body has been made. If we designate this length by $l$, we can calculate the wave length by dividing the velocity $v$ of sound in a second by $n$, the number of vibrations the sounding body makes in a second; or, $l=\frac{v}{n}$. By a sonorous wave surface is understood that surface which is at such a distance from the point or points of origin of the sound that all points in that surface have the same phase of vibration at the same instant of time. Thus, it is evident that if we have a small sphere of air which successively and rapidly increases and diminishes its volume, we shall have alternate spherical shells of compressed and of rarefied air surrounding the vibrating sphere. If we view a surface in one of these shells, in every part of which surface the particles of air are moving in the same direction with the same velocity, we shall have the sonorous wave surface. The acoustic wave lengths and wave surfaces are not mere creations of the imagination, but have a real existence. The author of this article first devised a method by which one can readily detect the phases of vibration in the air surrounding a sounding body, and

thereby has succeeded in measuring directly in the vibrating air the length of sonorous waves, and has determined in the air surrounding the vibrating body the form of the wave surface. ("American Journal of Science," November, 1872.) It is evident that the ultimate effect of the passage of sonorous waves through the atmosphere will be to cause the molecules of the air to swing to and fro with the motions of pendulums. It is also apparent that all the characteristics of the periodic motion at the source of the sound will be impressed on the surrounding air and transmitted through it to a distance.—*Reflection of Sound.* It follows from the very nature of sound pulses that if a sonorous wave meet a hard smooth surface, or encounter the surface of separation of two media of unequal elasticity, reflection of sound will take place, and the laws of reflection will be the same as in the case of light, viz.: the angle of reflection will equal the angle of incidence, and both the incident and reflected ray will lie in the same plane, which is at right angles to the reflecting surface. These laws admit of a ready experimental proof. If two concave parabolic mirrors, formed of metal backed with hard wood or plaster of Paris, be placed opposite each other at a distance of 10 or 15 ft. with the axis of the mirrors in the same line, and a watch be placed in the focus of one of the mirrors, it will be found that the sonorous pulses emanating from the watch will be reflected from the first mirror upon the surface of the second mirror, and here by a second reflection will be conveyed to the focus. This fact can be ascertained by leading to the focus a tube terminated at one end by a small funnel, while the ear is applied to the other end of the tube. In the article OPTICS it has been shown that the action just described is a necessary consequence of the laws of reflection given above.—*Refraction of Sound.* Sound waves are also refracted, and their refraction is due to the same cause which produces refraction of the rays of light; *i. e.*, to the change in velocity which occurs when the sonorous beam enters a refracting medium. When the sonorous wave surface falls upon the refracting medium so that it is parallel to the refracting surface, there will be no refraction, or change in the direction of the sound, but only a change of velocity. But when the sonorous wave surface forms an angle with the surface of the refracting medium, the change in velocity causes the refraction of the sonorous beam, so that if the velocity of the sound is less in the refracting medium than it was before it entered it, the sound will be refracted toward the perpendicular to the refracting surface. The refraction will be away from the perpendicular when the velocity of the sound is greater in the refracting medium than it was before it entered it. It follows from the above action, that for the same media there will be a constant ratio existing between the sines of the angles of incidence and refraction, and also that the incident and refracted ray will be in the same plane at right angles to the refracting surface. (See LIGHT, vol. x., p. 439.) The experimental verification of these laws, however, is not so easy as in the similar phenomena of light. The experiment

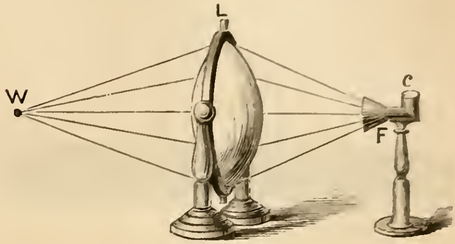


FIG. 17.

best adapted for this purpose is one devised by Sondhaus and represented in fig. 17. He constructed a lens, L, of sheets of collodion, having the form of portions of a sphere, and united these sheets to the opposite sides of a metal ring. On inflating the envelope thus formed with carbonic acid gas, a lenticular form was given to it. A watch was placed at W, on the axis of the lens, and it was found that the sound waves were refracted to the conjugate focus of the lens at F. If at F we place a bent pipe with a funnel-shaped mouth, and replace the watch at W by a small organ pipe, the refraction is detected by seeing grains of a light powder dance on the membrane closing the upper mouth of the bent pipe at *c*.—*Interference of Sound.* Another necessary consequence of the nature of sound vibrations and of the manner of their propagation is, that if the condensed half of a sonorous wave meet the rarefied half of another sonorous wave, and these waves have the same length and the same energy of vibration, there can be no vibratory motion at their place of meeting, for the directions of the vibrations in the two half waves are opposed, and the intensities of these opposed vibratory motions are equal. These conditions are fulfilled in various well known experiments, and it is one of the best established facts in acoustics that two sound vibrations may meet and produce silence at the place of their meeting; this is known as the phenomenon of the interference of sound. Dr. Thomas Young studied this phenomenon attentively, and its contemplation led to his great discovery of the similar phenomena of the interference of light, which formed the basis of his reasoning in establishing the undulatory theory of light. To Dr. Young we owe one of the simplest known means of exhibiting and studying the phenomena of interference of sound. If a vibrating tuning fork be held in a vertical position at a short distance from the ear, and then rotated around its vertical axis, it may be observed, when the

surfaces of the prongs of the fork are opposite the ear, that sound will be perceived; but when the edges of the fork formed by the meeting of those surfaces are opposite the ear, it will be found that no sound, but entire silence, occurs. This phenomenon is readily explained. First, it is necessary to know that the prongs of a vibrating fork alternately approach to and recede from each other, as is readily seen when we obtain on a piece of smoked glass the trace of two delicate wires attached to the ends of the prongs of the vibrating fork. A trace thus made is accurately shown in fig. 18. When the prongs recede

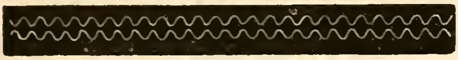


Fig. 18.

from each other, condensations will be produced in the air opposite the faces $c\,c'$ (see fig. 19, which represents a plan of the ends of the prongs); but while these condensations are thus formed rarefactions are produced in the air opposite the opening between the prongs at $r\,r'$. The reverse of these actions occurs when the prongs approach each other. The result of the actions will be evident from the figure, where the full lines show the centres of shells

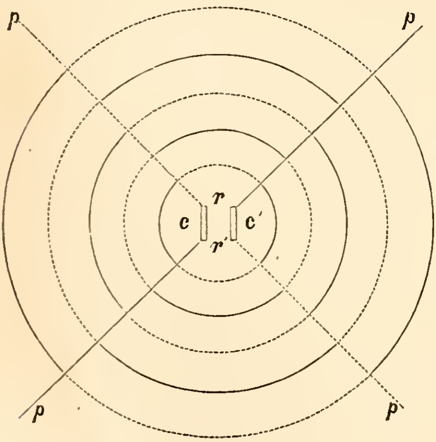



Fig. 19.

of condensed air, and the dotted lines the centres of shells of rarefied air. These shells alternate, and meeting along the planes $p, p, p, p$, passing through the vertical edges of the fork, they neutralize each other's action. W. Weber has shown that the points of quiescence in this case must lie in hyperbolic sheets. This must be so, for the difference in the distance of every point of quiescence from two fixed points must be a constant quantity, which in this experiment will be equal to the half of the wave length given by the fork. The writer has used this experiment of Young to show the reflection of sound from flames and from sheets of cold and heated gases, such as carbonic acid gas and hydrogen. Two resonators were placed as in fig. 20 with the planes of their mouths at

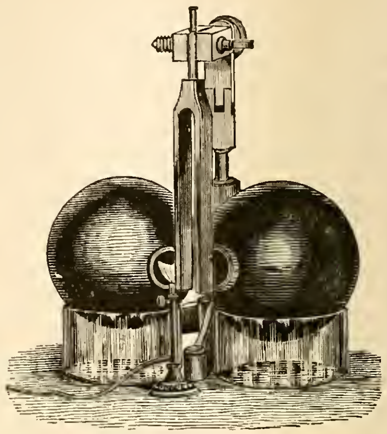


Fig. 20.

a right angle, and in this angle was firmly fixed the fork to whose note the resonator resounded. The broad face of one of its prongs faced the mouth of one resonator, while the space between the prongs faced the mouth of the other resonator. By trial the two planes of the fork are placed at such distances from the resonators that complete interference of the vibrations issuing from their mouths is obtained, and the only sound that reaches the ear is the faint one given by the action of the fork on the air outside the angle included by the mouths of the resonators. If in these circumstances we place before the mouth of one of the resonators a flat coal-gas flame, we shall find that this flame reflects part of the sound which falls upon it, and thus partially screens the resonator, so that sonorous vibrations of diminished intensity now enter this resonator, and therefore the balance of interference no longer exists, and a sound issues from the resonator which has not the gas flame opposite its mouth. But if a piece of French tracing paper be placed before the mouth of the latter resonator, the balance of interference will be restored, thus showing that the reflecting power of a gas flame is equal to that of tracing paper. In a similar manner the writer has shown and approximately measured the reflecting power of sheets of cold carbonic acid and hydrogen gases.—*Change of Pitch caused by Translation of the Sounding Body.* One of the most remarkable phenomena is the change in pitch caused by the motion of a sounding body to or from the ear; or, what is the same, by the motion of the ear to or from the source of sound. When the sounding body and the ear approach, we perceive a rise in the pitch; when they recede from each other, a fall in pitch occurs. This is a fact known to all who have listened to the rapid change in pitch of a locomotive whistle which

occurs at the instant it passes us; the same phenomenon is yet more marked when the listener is on a train which passes another going in the opposite direction while the whistle of the latter is sounding. If we suppose each train to be moving at the rate of 30 m. an hour, and the pitch of the whistle while the trains are approaching each other to be that of the C next above the treble, the pitch will fall about a tone while the trains are receding from each other. The following simple considerations will afford the means of calculating the change in wave length produced by a known velocity given to a sounding body of a given pitch, and will also serve to solve the inverse problem, viz., the velocity of the sounding body which causes an observed change in its pitch. If the sounding body moves toward the ear over a space S in one second, it is evident that in these conditions more vibrations or wave lengths will enter the ear by the number of wave lengths contained in S. If $l$ represent the wave length produced by the vibrating body when it is stationary, and $l'$ the wave length when it moves toward the ear, N the number of vibrations per second of the sounding body, and V the velocity of sound per second, we shall have $N=\frac{V}{l}$, and $l'=l\left(\frac{V}{V+S}\right)$; and S, the velocity of the sounding body per second, will be $S=V\left(\frac{l-l'}{l'}\right)$.—*Perception of Sounds and their Analysis by the Ear.* The ear may be divided into three portions: the outer, the middle, and the inner ear. (See EAR.) The organ of Corti is enclosed in the ductus cochlearis of the inner ear, a canal of triangular section which forms an ascending spiral of two and a half turns around the modiolus. It is bounded on two of its sides by the scalæ, and on its third by the membranes lining the outer wall of the cochlea. The upper wall of the ductus cochlearis is formed by the membrana Reissneri, which separates it from the scala vestibuli, and its lower wall is the lamina spiralis and the elastic membrana basilaris, which separate it from the scala tympani. The ductus is closed at its upper end, and at its lower end it communicates with the sacculus hemisphericus by a fine duct. The arch of Corti rests upon the membrana basilaris, which extends beyond the base of the arch to the membranous outer wall of the cochlea; and over the arch spreads the membrana tectoria, covering the rods of Corti and the hair-cell chords as with a roof, but leaving the outer portion of the elastic membrana basilaris exposed. The effect of these anatomical relations is to bring the sound vibrations to act with the greatest advantage on the hair-cell chords, which are supposed to be the parts of the inner ear that are tuned to the range of sounds appreciated as musical by the human ear. If a simple sonorous vibration enter the inner ear, then one of these chords, vibrating synchronously with it, will shake the nerve fibril attached to this chord, and thus give the sensation of a simple sound; but if a composite sonorous vibration enter the ear, several chords will enter into vibration, each vibrating to one of the definite simple vibrations forming the components of the compound sound. These hair-cell chords may be compared to the tuned strings in a pianoforte, which readily respond to a note sung over them. If the note be formed of a simple sound, then only one string of the piano will answer back. If the sound be composite, the strings will decompose it into its simple component sounds, and the position of these simple sounds in the musical scale can be determined by observing which of the strings of the piano have entered into vibration. This experiment shows how the ear is supposed to appreciate a simple sound, and to decompose a compound sound into its simple sonorous sensations. The relation of the various parts of the inner ear is such as to cause the chords of the organ of Corti and their attached nerve filaments to make half as many vibrations in a given time as are made in the same time by the membrane of the drum of the ear. The relations which the form of the scalæ bears to the sonorous waves traversing them will be modified according to the existence or non-existence of a communication between the scalæ. On this point there seems to be some difference of opinion; but in explaining the functions of the scalæ, first on the supposition that the scalæ are continuous, and then on the assumption that they are not continuous, but closed at the place where the passage called the helicotrema is supposed to exist, it will be made highly probable that no communication exists between the scalæ, or at least if one exist it must be by a very contracted passage. E. Weber was the first to point out the peculiar molecular actions which exist when the dimensions of a body are very small compared with the length of the sonorous waves which traverse it; and Helmholtz based his investigations on "The Mechanism of the Ossicles of the Ear" on the theory of Weber, which Helmholtz gives in these words: "The difference in displacement of two oscillating particles, whose distance from one another is infinitely small compared with the wave length, is itself infinitely small compared with the entire amplitude of displacement." It is evident that the sonorous compressions and dilatations which may exist in any body depend entirely on the differences in the phases of the vibrations constituting the sonorous wave, and when the body has a depth equal to half a wave length it can embrace the maximum amounts of condensation and of rarefaction. But condensation and rarefaction can alone produce lateral action on the walls of a straight canal traversed by sonorous vibrations; and hence, if the length of the canal be but a small fraction of the wave, there exists throughout the canal but little difference in phase of vibration, and therefore but little lateral action. The united length of the scalæ is but a small

fraction of the mean length of the sonorous waves which traverse it; for if we take $4\frac{1}{2}$ metres as the mean length of the waves which are propagated through the scalæ, and 59 millimetres as the length of the united scalæ, it follows that the latter is only $\frac{1}{75}$ of the mean wave length. Now if we imagine the scalæ straightened, and as forming one continuous tube with a free communication at the helicotrema, then the mean wave traversing them will cause only $\frac{1}{37}$ of the lateral action which this same wave would produce if the scalæ had the length of one half of the wave; and it follows that the whole liquid of the scalæ will vibrate forward and backward almost as an incompressible mass, approaching in character the oscillations of a solid piston in a cylinder; therefore, the action against the walls of the ductus cochlearis will be very slight. But now consider the change in effect on the ductus which takes place when it, together with the scalæ, is wound up into such an ascending spiral as really exists in the ear. The molecules of the liquid in the scalæ, thrown forward and backward by the vibrations of the stirrup bone, tend to move in straight lines, but the curved form of the scalæ causes them to press against the outer or peripheral part of the upper wall (membrana Reissneri) of the ductus cochlearis and against the outer part of the lower wall (membrana basilaris) when the stirrup bone moves inward, and when it moves outward this action of compression is relieved from the two opposite walls of the ductus. But these actions on the walls of the ductus, produced by the vibrations of the stirrup bone, are opposed to each other, and since they take place simultaneously and with about the same intensity (by reason of the assumption of the free communication of the scalæ), the hair-cell chords cannot vibrate, but will only experience compressions and dilatations like the fluid in which they are immersed. Therefore, there appears a physical basis for the opinion that either there is no communication between the scalæ, or if one exist it must be through a very constricted passage. Indeed, if we adopt the latter view, then everything works to produce the maximum effect upon the co-vibrating chords of the organ of Corti; for, when the stirrup bone moves inward, the pressure is thrown upon the outer border of the upper wall or roof of the ductus, thence across to the peripheral portion of the basilar membrane. This action, we may say, takes place simultaneously throughout the whole length of the ductus, moves downward the floor of the basilar membrane, and thus presses the fluid of the scala tympani against the sound membrane and moves this membrane outward. But when the stirrup bone moves outward, the pressure is relieved from the elastic basilar membrane which is now moved upward, while the round membrane moves inward. There are also other anatomical facts besides the inclination of the membrana Reissneri to the plane of the membrana basilaris, and the inclination of both these membranes to the plane perpendicular to the axis of the cochlea, which favors an opinion that the outer or peripheral part of the basilar membrane receives the main part of the vibrations which enter the ductus cochlearis. The auditory nerve fibrils are not attached to the Corti rods or pillars, as was formerly imagined; and hence these bodies cannot be the co-vibrating parts of the ductus; but the Corti pillars appear to act as supports for the lamina reticularis, between which and the basilar membrane are steadily and tensely stretched the hair-cell chords, and to these chords are attached the auditory nerve fibrils. The very fact that the number of these hair-cell chords increases with the higher development of the ear, shows their important functions; for, while in man they are arranged alternately in five rows and number 18,000, in other mammalia there are only two or three rows. These hair-cell chords are more perpendicular to the basilar membrane than the Corti rods, and are also different in their forms, having swellings in the middle of their lengths. These swellings must cause them to act like loaded strings, and thus each hair-cell chord is peculiarly well adapted to co-vibrate with only one special sound. And these hair-cell chords are so directed in reference to the sound pulses which enter the ductus that their lengths are in the direction of these pulses, and therefore they cannot be directly set in motion by these vibrations. Indeed, they appear to hold the same relation to those vibrations as the antennal fibrils of the mosquito bear to sound vibrations which exist in the directions of these fibrils. The writer has shown by direct experiment ("American Journal of Science," August, 1874) that in these conditions the fibrils of the mosquito remain at rest, although when the same sound pulses fall athwart the fibril it may be set into energetic vibrations. The hair-cell chords, therefore, cannot be set into vibration by the action of the feeble pulses which may reach them directly through the membrana Reissneri from the scala vestibuli; and furthermore, the shielding influence of the membrana tectoria tends to prevent this direct action on the chords. If this view be correct, that these chords receive their vibrations from the basilar membrane, to which their ends are attached, and not directly from the impulses sent into the ductus, it necessarily follows that these chords bear to the membrane to which they are stretched the same relation as stretched strings bear to the vibrating tuning forks to which they are stretched in directions perpendicular to the lengths of the forks. Hence it follows that a chord in the ductus will vibrate only half as often as the basilar membrane to which it is fastened. As the basilar membrane, the tympanic membrane, and the air contiguous to the latter vibrate together, it follows that the auditory nerve fibrils vibrate as frequently as the tympanic membrane and the molecules of air outside of the

head. The following experiment illustrates very well the foregoing explanation of the mode of audition. A membrane, loosely stretched on a frame, is placed in a vertical position near a reed pipe, which, as we have already seen, gives a highly composite sound. Strings of various lengths and diameters, loaded at their centres, are fastened to the membrane and stretched to a fixed support. On sounding the reed pipe, only those strings in tune with the harmonics, or simple sounds, existing in the sound of the reed pipe, will enter into vibration; similarly, when the sound of the same reed pipe enters the ear and vibrates the basilar membrane, the only hair-cell chords which enter into vibration are those which are in tune with the elementary vibrations existing in the composite sonorous vibration produced by the reed pipe. And it is to be observed that as the loaded string makes one vibration to two of the membrane, so the hair-cell chord makes only one vibration to two of the basilar membrane or of the membrane of the drum of the ear. If it be true that when simple vibrations impinge on the ear the tympanic and basilar membranes vibrate twice, while the co-vibrating body only vibrates once, it follows that if the same simple vibrations be sent directly to the co-vibrating parts of the ear, without the intervention of the basilar membrane, we shall perceive a sound which is the octave of the one experienced when the same simple vibrations entered the ear through the tympanic membrane. Hence it appears that this hypothesis can be brought to the test of experiment in the following manner: If we vibrate a fork near the ear, and closely apprehend the character of its sound, we experience a sensation which certainly does not contain that corresponding to the higher octave of the fork. Now press the foot of the fork firmly against the zygomatic process, close to the ear, directing it somewhat backward, and we shall distinctly hear the higher octave of the fork singing in concert with its real note. If the auditory canal be now closed by gently placing the tip of the finger over it, we shall perceive the higher octave with an intensity almost equal to that of the fundamental note. The same sensation, though less intense, may be obtained by placing the fork on any part of the temporal bone. One can also perceive distinctly the higher octave when the fork is placed on the parietal bone, about two inches in front and an inch or so to the side of the foramen, with its foot directed toward the opposite inner ear, while the auditory canal of this ear is gently closed with the finger. In these circumstances the higher octave is often heard, with some persons, to the almost entire exclusion of the lower, or of the proper note of the fork. These experiments have been made on the ears of several accomplished musicians, and the results have invariably agreed with those described above.—*Duration of residual Sonorous Sensations.* For a long time it has been known that the sensation of light endures an appreciable time after the cessation of the entrance of light into the eye. The durations of the residual sensations corresponding to lights of different colors and intensities have been generally determined by finding the number of flashes of a given light in a second required to blend and produce a continuous sensation. The durations of the residual sonorous sensations had never been made the subject of investigation until the writer began the study of these phenomena, and succeeded in determining the law connecting the pitch of a sound with the duration of its residual sonorous sensation. The manner of determining the data of this law is similar to the method employed in the study of the analogical phenomena of light. Intermittent sonorous pulses were sent into the ear by means of perforated revolving disks, and the rotation of the disk was brought just to that velocity required to blend the separated pulses. It was thus found that if we represent by N the number of vibrations per second producing a given sound, and by D the duration of the residual sonorous sensation of this sound, then the law connecting the pitch, or number of vibrations per second, with the duration of the sonorous sensation, will be expressed by $D=\left(\frac{53248}{N+23}+24\right)\cdot 0001$. This is the expression of the law given in the article HARMONY. Besides the application of this law to the elucidation of the fundamental facts of musical harmony, there are other and new classes of phenomena which it has served to point out. For instance, as the duration of the residual sonorous sensation is less as the pitch of the sound is higher, it follows that at the instant of the cessation of the aërial vibration, producing a given composite sound, the timbre of this sound must instantly begin to change; for the residual sensations of the higher harmonics will disappear one after another, in the order of descending pitch, until there remains in the ear only the sensation corresponding to that of the lowest or fundamental harmonic. The knowledge of the law given above led to a new method of analyzing a composite sound by means of a perforated rotating disk. Thus, on rotating with great velocity a large disk, with sections cut out of it, before a reed pipe, and placing the ear close to the disk, we have the composite sound reaching the ear in a series of impacts which succeed each other so rapidly that even those of the highest harmonic of the reed blend into a continuous sensation; but on gradually lowering the velocity of rotation, the impacts of this highest harmonic can no longer blend, and we perceive this harmonic beating alone on the ear. This fact can more readily be confirmed by the aid of the resonator corresponding to this harmonic. A further slight lowering of the velocity of rotation brings out the beats of the next lower har-

monic, and so on, until the velocity has been so diminished that the beats of the lowest or fundamental harmonic are perceived. Then all the component sounds of the reed are beating on the ear in unison, but the effects they severally produce on the ear are very different; for the higher harmonics, notwithstanding their feebler intensities, must be heard more distinctly, because their intermittences are the furthest removed from the number that cause the blending of their separate impulses. In other words, the number of impacts of the highest harmonics approaches nearer than the lower to the number of beats required to cause them to give their greatest dissonant effects; it having been determined that it requires about $\frac{4}{10}$ of the number of sonorous impacts, which blend into a continuous sound, to produce the most dissonant sensation that can be obtained by a series of separated beats falling on the ear.—The following are the most important works on sound: Chladni, *Traité d'acoustique* (Paris, 1809); Peirce, "An Elementary Treatise on Sound" (Boston, 1836), which contains an excellent catalogue of works and memoirs on the subject; Airy, "On Sound and Atmospheric Vibrations, with the Mathematical Elements of Music" (London, 1868); Donkin, "Acoustics" (Oxford, 1870); *Acoustique*, in Daguin's *Traité de physique* (Paris, 1870); *Akustik*, in vol. i. of Wüllner's *Lehrbuch der Experimentalphysik* (Leipsic, 1870); Helmholtz, *Die Lehre von den Tonempfindungen* (Brunswick, 3d ed., 1870; English translation, by A. J. Ellis, 1875); Sedley Taylor, "Sound and Harmony" (1873); Tyndall, "On Sound" (new ed., 1875); and A. Guillemin, *Le son: notions d'acoustique physique et musicale* (1875).

**SOUND, The**, a narrow strait, forming one of the passages between the Cattegat and the Baltic, and separating the Danish island of Seeland from the coast of Sweden. In its largest sense it extends N. and S. 66 m., and opposite Copenhagen it is about 15 m. wide. But the name is properly confined to the narrowest part of the passage, which between Elsinore and Helsingborg is not more than 3 m. wide. The Great Belt gives a wider and deeper communication between the Cattegat and the Baltic, but the Sound is most frequented because shorter and favored with better winds. The depth ranges from 4 to 20 fathoms. The Danish kings formerly owned the territory on both sides of the strait, and from time immemorial levied duties on all vessels passing through it; but this is done no longer, the right having been bought off by other nations, under treaties concluded in 1857.

**SOUNDING.** See ATLANTIC OCEAN, vol. ii., p. 69, and DREDGING, DEEP-SEA.

**SOUR GUM.** See TUPELO.

**SOUTH, Robert**, an English clergyman, born at Hackney, Middlesex, in 1633, died in London, July 8, 1716. He graduated at Christ Church college, Oxford, in 1655, was ordained in 1658, was elected public orator of the university in 1660, soon afterward became chaplain to the chancellor Clarendon, and was made a prebendary of Westminster in 1663, and a canon of Christ church, Oxford, in 1670. He was a zealous champion of passive obedience and the divine right, and was opposed alike to Protestant dissent and to Roman Catholicism. When Sherlock published his "Vindication of the Holy and Ever Blessed Trinity," South attacked him for inculcating tritheism (1693). His sermons have passed through many editions (6 vols., 1692; 5 vols. additional, 1744; 4 vols., London, 1843; 2 vols. royal 8vo, Edinburgh, 1843; abridged, London, 1851 and 1859); and a volume of his posthumous works appeared in 1717.

**SOUTH ADAMS.** See ADAMS, Mass.

**SOUTH AMERICA.** See AMERICA.

**SOUTHAMPTON**, a S. E. county of Virginia, bordering on North Carolina, bounded E. by the Blackwater river and S. W. by the Meherrin, and intersected by the Nottaway; area, 600 sq. m.; pop. in 1870, 12,285, of whom 6,795 were colored. The surface is nearly level and diversified by large forests of cypress and pine, and the soil is tolerably productive. Tar and turpentine are largely exported. It is traversed by the Seaboard and Roanoke and the Atlantic, Mississippi, and Ohio railroads. The chief productions in 1870 were 218,858 bushels of Indian corn, 13,683 of oats, 24,927 of sweet potatoes, 3,587 lbs. of wool, and 18,660 of butter. There were 909 horses, 1,385 milch cows, 3,308 other cattle, 2,576 sheep, and 12,978 swine. Capital, Jerusalem.

**SOUTHAMPTON**, a seaport town of Hampshire, England, and a county of itself, on the peninsula formed by the estuary of the river Itchen and the larger estuary of the Test, called the Southampton water, 70 m. S. W. of London; pop. in 1871, 53,741. The Southampton water varies in breadth from 1½ to 2 m., and extends inland from Calshot castle, 7 m. below Southampton, to Red Bridge, 4 m. above. The entrance is well sheltered by the isle of Wight, and the channel is deep and straight, with good anchorage. It has the advantage of four tides in the 24 hours; a peculiarity caused by the isle of Wight intercepting a portion of the tidal wave in its progress both ways through the English channel. The mean rise of the spring tides is 18 ft., and of the neap tides 8 ft. The town is well built, and supplied with pure spring water from an artesian well 910 ft. deep. It has a well wooded park of 365 acres, 5 parish churches, 13 other churches, a public library and museum, and several charitable, literary, and scientific institutions. Among the noteworthy public buildings are the custom house, the ordnance survey office, the royal Victoria hospital for 1,200 invalid soldiers, and the royal southern yacht club house. For many years Southampton was mainly a watering place, but since the opening of the docks in 1842 it has become the principal port of departure

for several East and West India, China, Australia, North German, and American steamship lines, besides having a large trade coastwise and with the continent. There are five docks, paved with granite and lined with warehouses, viz.: one of 10 acres, two of 16 acres each, and two of 22 acres each; and further shipping accommodations, begun in 1873, include a quay 1,500 ft. long on the right bank of the Itchen, which is ultimately to form the E. arm of a dock of 30 acres. The entrances in 1873 were 6,920 British vessels, tonnage 852,461, and 578 foreign vessels, tonnage 376,964; clearances, 6,839 British vessels, tonnage 832,617, and 543 foreign vessels, tonnage 347,710. The total value of exports was £11,459,889. The principal industries are brewing, sugar refining, iron casting, coach building, and ship building; many large steamships have been built here. The annual cattle fair is important.—Southampton is a very ancient place. Remains of the Roman camp Clausentum, 1 m. N. E. of the present town, are still seen. The bar across High street and the W. and S. gates, now standing, are parts of the Saxon walls around the old town. In 980 the Danes sacked the place. After 1016 it was the occasional residence of Canute, and the shore is said to be the scene of his rebuke to his courtiers. The town was destroyed by French, Spanish, and Genoese allies in 1338, was rebuilt and fortified by Richard II., and was erected into a county of itself by Henry VI.

**SOUTHAMPTON, Henry Wriothesley,** third earl of, an English statesman, born Oct. 6, 1573, died in Holland, Nov. 10, 1624. When he was 20 years old Shakespeare dedicated to him his poem of "Venus and Adonis," and in the next year "The Rape of Lucrece." Sir Edwin Sandys converted him to Protestantism. In 1596 he took part in the expedition of the earl of Essex against Cadiz. In 1599, accompanying Essex to Ireland, he was made general of horse. From that command he was recalled by the queen, and went speedily into the Netherlands. On his recall from that country he confederated with Essex and appeared with him in the insurrection which he then made in London. On his trial for treason he protested that he had never entertained a thought against the queen; sentence of death and attainder was passed against him, but he was immediately relieved of the former by the queen, and in the first year of James I. the attainder was removed by act of parliament. As an assign of Sir Walter Raleigh he took part in colonizing America, and in 1602 sent out the Concord under Gosnold. He interested those connected with him, Lord Arundel, his brother-in-law, and Cecil Calvert, afterward Lord Baltimore, who was Lord Arundel's son-in-law. In 1605, in conjunction with Lord Arundel, he despatched Waymouth to New England. The secretary of Virginia ascribes to him the principal part in obtaining the first charter for the London company of Virginia, though his name does not appear in the charter itself. In the second charter his name stands next to those of the high officers of state. The firm friend of Sir Edwin Sandys, when the latter retired from the office of treasurer (governor) of the company, Southampton was unanimously chosen in his stead, and he remained in the chair till the charter was taken away. In parliament he was one of the firmest supporters of liberty. In June, 1621, he was committed to close custody by the king, and he asked to know the charges against him and to see his accusers. The tendency of his mind in religious affairs appears from the charge made against him of corresponding with the Independents. The duke of Buckingham visited him in prison and caused him to be set free, but he was watched till near the end of August, when by the king's direction Sir George Calvert as secretary of state gave him his liberty. After the suppression of the Virginia company he went to the Netherlands to fight for Dutch independence, and took command of a regiment. In their winter quarters at Rozendaal he and his son were both seized with burning fever. The son died; the father recovered enough to depart from Rozendaal with the intention to bring his son's body to England, but died at Bergen-op-Zoom. He is the only man from whom Shakespeare acknowledges having received a benefit.

**SOUTHAMPTONSHIRE.** See HAMPSHIRE.

**SOUTH AUSTRALIA,** a British colony in Australia, comprising all of the continent between the 129th and 138th meridians of E. longitude N. of lat. 26° S., and between the 129th and 141st meridians S. of that latitude, bounded N. by the gulf of Carpentaria and the Indian ocean, E. by Queensland, New South Wales, and Victoria, S. by the S. Pacific ocean, and W. by Western Australia; area, according to latest estimates, about 900.000 sq. m.; pop. (exclusive of about 3,000 aborigines) in 1871, 185,626; in 1874 (estimated), 202,185. Capital, Adelaide. In the article AUSTRALIA, South Australia and the Northern Territory are treated as distinct; but the latter is now an integral part of South Australia, or rather a subcolony, as it is governed directly by the executive of that colony and has no representation in its parliament. It embraces the larger and almost uninhabited half of the colony, N. of lat. 24°. Within the limits of South Australia are included Kangaroo island, about 100 m. long and 30 broad, on the S. coast, and Melville island, 1,800 sq. m., and several smaller islands, on the N. coast.—The S. coast, which forms the E. and a part of the N. shore of the Great Australian bight, has a general N. W. and S. E. direction. Its principal inlets are Encounter bay, St. Vincent gulf, in the mouth of which lies Kangaroo island, and Spencer gulf, which extends more than 200 m. inland. It has many good harbors, of which Port Lincoln on Spencer gulf is the best. The N. coast, as far as Cape Arnhem, forms the W. shore of the gulf of

Carpentaria. Beyond that the chief inlets are Arnhem bay, Castlereagh bay, Mt. Morris bay, Port Essington, Van Diemen's gulf, Port Darwin, Anson bay, and Queen's channel. South Australia contains a great variety of soils and scenery, almost every kind of landscape being found within its limits. Much of it, particularly in the north, is sterile and uninviting, consisting largely of scrub and rock, but at least a third of its surface is agricultural and pastoral land, and another third wooded ranges suitable for pasturage. The scrub land is valuable only for its mineral wealth, some of the richest mines having been discovered in it. The principal chain of mountains is the Flinders range, which extends from Cape Jervis northward to the vicinity of Lake Blanche, about lat. 29°; its highest peak is Mt. Remarkable, 3,179 ft. The Gawler range, in the peninsula W. of Spencer gulf, has a height in its W. part of about 2,000 ft. N. of this are the Warburton and Stuart ranges, and there are many others stretching across the continent to the N. coast.—The Murray river enters the colony about lat. 34° S., and after a course of about 250 m., all of which is navigable, flows into Lake Alexandrina, and thence into Encounter bay by a narrow opening called the Murray mouth. The Wakefield and Gawler rivers flow W. into the gulf of St. Vincent. From the Torrens, which loses itself in reed swamps, the city of Adelaide derives its supply of water. On the N. coast the principal rivers are the Liverpool, the East and the South Alligator, the Adelaide, the Daly, and the Victoria. The Roper, which flows into the gulf of Carpentaria, is navigable for large vessels for nearly 100 m. There are many lakes, particularly in the S. E. part, which is called the lake district. Lakes Eyre, Torrens, and Gairdner are large bodies of salt water, each more than 150 m. long. Lake Eyre is only 70 ft. above the sea, while Gairdner, which lies N. of the Gawler range, is 366 ft. high. Lake Alexandrina is about 30 m. long and 15 m. wide. From its E. side a narrow lagoon, called the Coorong, extends about 85 m. parallel to the coast, from which it is separated by a narrow strip of land.—South Australia is rich in mineral resources. Iron ore abounds, but copper constitutes its chief wealth. The famous Burra-Burra mine, near Kooringa, about 100 m. N. by E. of Adelaide, was discovered in 1844 and opened in the same year. From 10,000 to 13,000 tons of ore are raised annually, yielding about 2,500 tons of pure copper. In 1860 the Wallaroo mines were opened near Kadina, on the shore of Spencer gulf, 91 m. N. W. of Adelaide. In 1861 the Moonta mines, about 12 m. distant, were discovered. They yield 25 per cent. of pure copper; in the first half of 1874 11,000 tons of ore were raised from them. In 1872 61 copper mines were worked, giving an aggregate annual yield of more than 150,000 tons. Gold has been discovered in several places, and 438 reefs were registered in 1870, giving an annual yield of 10,500 oz. Many small diamonds have been found near Echunga; and jasper, chalcedony, and opal abound. Silver, lead, and bismuth have also been found, and salt is abundant.—The climate of the inhabited part of the country is very fine, but that of the scrub land in the north is exceedingly hot and dry. In the southeast the seasons are the wet and the dry; the latter begins about the end of August and continues till the end of March. In December and January the heat is very great, and when the wind blows from the north the thermometer often rises to 115°. These winds are accompanied by clouds of dust, but seldom last more than a few hours, when they shift to the southwest and south, and the temperature falls. The average temperature is 67°, and the lowest in the level country 44°. The average annual rainfall is about 21 inches. Between March and August heavy rain falls, and the country becomes covered with luxuriant verdure; but during the summer months the ground is completely parched and the grass withered. The settled parts of South Australia, however, are not subject to the long continued droughts which are sometimes so destructive in New South Wales. No epidemic diseases prevail, affections of the lungs are infrequent, and scrofulous complaints are rare; but diseases of the eyes are common in summer. —The forests contain much large timber, but wood for cabinet and other fine work is imported. There are many species of *eucalypti* and acacias, and the pandanus, cycas, and *Adansonia* or gouty stem tree, the fruit of the last of which is eaten by the natives. In the northern parts three kinds of wild fig, a species of wild grape, and wild yams have been found. Native wheat and oats, rye grass, and rice grass also grow in the north. All the fruits common to temperate climates succeed remarkably well, and particularly the grape, many varieties of which are cultivated. Agriculture has made great advances of late, and the colony promises to become a large grain-producing country, enough wheat being grown in some years to supply the neighboring colonies and to ship many cargoes to England, where it brings high prices. The extent of land under cultivation in the year ending March 31, 1873, was 1,164,846 acres, an increase of 120,190 acres over the preceding year. The number of acres in wheat in the same year was 759,811, and in the year ending in March, 1874, 784,784; the product in the last named year was 6,178,816 bushels. In 1873 there were 5,424 acres of vineyards, and 2,901 in orchards. The return of live stock in 1873 was: sheep, 4,900,687; cattle, 151,662; horses, 82,215; goats, 17,492; pigs, 98,436; poultry, 513,883. The kangaroo dog, a cross between the greyhound and the English bulldog, often exceeding 3 ft. in height, is valuable to the inhabitants of this as well as the other Australian colonies. Much damage is sometimes done to the green crops by locusts.

For the indigenous fauna see AUSTRALIA.—The government of South Australia consists of a governor appointed by the crown, an executive council, and two houses of legislature, one called the legislative council and the other the house of assembly. The legislative council is composed of 18 members, elected by general vote for twelve years, one third retiring every four years. The president is elected by the members. The governor has no power to dissolve the council. The house of assembly has now 46 members, who are elected for three years. This body is liable to dissolution by the executive. The revenue of the colony in 1873 was £972,813, and the expenditure £839,152. The colonial debt on Dec. 31, 1873, was £2,174,900.—In 1871 there were 3,372 aborigines, who are of the same general type as those of other parts of Australia, but four different dialects are spoken by them within the limits of the colony, three of which are not intelligible to the natives of the country about the mouth of the Murray river. The tribes within the settled districts are inoffensive, and some of the boys are employed as herdsmen. The leading religious denominations in 1871 were: Church of England, 50,849; Roman Catholics, 28,668; Wesleyans, 17,075; Lutherans, 15,412; Presbyterians, 13,371; Baptists, 8,731; Primitive Methodists, 8,207; Congregationalists, 7,969; Bible Christians, 7,758; and several others were represented. The aggregate number of churches and chapels in the colony in 1872 was 607, with seats for 119,087 persons. The educational system is under the control of a central board consisting of seven members. The total number of licensed schools at the close of 1872 was 307; the number of scholars on the rolls was 15,123. A university is about to be established at Adelaide.—The exports of South Australia consist of grain, flour, wool, tallow, bark, fruit, wine, spirits, hides, beef, copper ore, copper, lead, and gold; their value in 1873 was £4,285,191. The imports consist principally of manufactured goods and articles of luxury; they amounted in the same year to £3,829,831. The entrances in 1873 were 457 vessels of 190,036 tons, and the clearances 363 vessels of 160,414 tons. In 1873 about 200 m. of railway had been completed, the principal line being the north line from Adelaide to Burra, about 100 m., with a branch line of 48 m. to Kapunda. A line connecting Narracoorte with Kingston is now constructing, and several others (one from Kadina to Port Wakefield, 32 m.) are authorized. There is telegraphic communication with the principal places in Victoria, New South Wales, and Queensland, and by the great overland line with Port Darwin on the N. coast, which is connected with Java by a submarine cable. The aggregate length of the lines in 1873 was 1,718 m.—In 1835 a company, styled the "South Australian Colonization Association," obtained a grant from the British government of the great tract of land which forms the colony of South Australia, and their first settlement was formed in December, 1836. Their operations gave rise to speculation in the lands of the colony, both there and in England, town allotments which had been originally sold at £2 10*s.* an acre soon rising to £2,000 or £3,000, and country sections from £1 to £100 an acre. Building speculations equally extravagant were carried on, and laborers' wages rose to 15*s.* and £1 a day. In 1839 a reaction took place which brought about the ruin of the land owners and most of the small moneyed settlers. Emigration turned to the other colonies, and South Australia became greatly depressed; but soon afterward the discovery of copper caused a reaction, and the colony prospered till 1851, when the discovery of gold in Victoria drew off thousands of its population and again retarded its growth. Since 1855 it has gradually recovered, and it is now once more prosperous.

**SOUTH BEND,** a city and the county seat of St. Joseph co., Indiana, on the S. bank of the St. Joseph river, at its most southern bend, 130 m. N. of Indianapolis and 85 m. E. by S. of Chicago; pop. in 1850, 1,652; in 1860, 3,832; in 1870, 7,206; in 1875, estimated by local authorities at 11,000. It is regularly laid out and substantially built, and is noted for its salubrity. It is well drained, and lighted with gas, and has water works and a good fire department. The court house is one of the finest buildings in the state. The river is navigable to this point, and affords good water power. The Lake Shore and Michigan Southern, the Michigan Central, and the Chicago and Lake Huron railroads meet here. An active trade is carried on in produce, lumber, and manufactured articles. Manufacturing is the chief interest; there were 2,183 hands employed in 1874, producing articles to the value of $4,318,722. The principal items were: flour, $385,000; carriages, wagons, &c., $1,266,000; farm machinery, $145,500; furniture, $256,000; doors, sash, and blinds, $163,000; foundery products, $440,620; sewing machines, $1,100,000; woollens, $80,000; paper, $330,402; brick, $75,000. The city has two national banks, a savings bank, and a life insurance company. There are six public school houses, with a high school; attendance in 1874, about 1,400. Other educational institutions are the university of Notre Dame and St. Mary's academy in the outskirts, and St. Joseph's academy within the city limits; these are Roman Catholic institutions, the last two for females. Three daily and four weekly (one German) newspapers and a monthly periodical are published. There are 11 churches. South Bend was laid out in 1831.

**SOUTH CAROLINA,** one of the original states of the American Union, lying between lat. 32° and 35° 10′ N., and lon. 78° 25′ and 83° 19′ W. It has the form of an irregular triangle, with the coast line for its base, and Georgia and North Carolina for its converging sides. Its extreme length, from Little River inlet on the

east to Chattooga river on the west, is about 275 m., and its greatest breadth, from the mouth of Savannah river on the south to the North Carolina line on the north, about 210 m.; area, about 34,000 sq. m. It is bounded N. and N. E. by North Carolina, S. E. by the Atlantic ocean,

State Seal of South Carolina.

and S. W. by Georgia, from which it is separated by the Savannah river and its upper branches. It is divided into 32 counties (called districts prior to 1868), viz.: Abbeville, Aiken, Anderson, Barnwell, Beaufort, Charleston, Chester, Chesterfield, Clarendon, Colleton, Darlington, Edgefield, Fairfield, Georgetown, Greenville, Horry, Kershaw, Lancaster, Laurens, Lexington, Marion, Marlborough, Newberry, Oconee, Orangeburg, Pickens, Richland, Spartanburg, Sumter, Union, Williamsburg, and York. The chief city is Charleston, which had 48,956 inhabitants in 1870 and 56,540 in 1875. Columbia (pop. in 1870, 9,298; in 1875, 14,449) is the capital. The chief towns having, according to the census of 1870, from 1,000 to 3,000 inhabitants are Abbeville, Greenville, Aiken, Georgetown, Newberry, Sumter, Beaufort, Anderson, Pickensville, Winnsborough, Spartanburg, and Camden. Other less important towns are Rock Hill, Cheraw, Cokesbury, Conwayborough, Edgefield, Greenwood, Lancaster, Marion, Pendleton, Walterboro, and Walhalla. The population of the state at decennial periods since 1790, according to the federal census, and in 1875 as reported by the state census, and its rank in the Union, have been as follows:

| YEARS. | White. | Free colored. | Slave. | Aggregate. | Rank. |
|---|---|---|---|---|---|
| 1790.... | 140,178 | 1,801 | 107,094 | 249,073 | 7 |
| 1800.... | 196,255 | 3,185 | 146,151 | 345,591 | 6 |
| 1810.... | 214,196 | 4,554 | 196,365 | 415,115 | 6 |
| 1820 ... | 237,440 | 6,826 | 258,475 | 502,741 | 8 |
| 1830.... | 257,863 | 7,921 | 315,401 | 581,185 | 9 |
| 1840.... | 259,084 | 8,276 | 327,038 | 594,398 | 11 |
| 1850.... | 274,563 | 8,960 | 384,984 | 668,507 | 14 |
| 1860.... | 291,300 | 9,914 | 402,406 | 703,708 | 18 |
| 1870.... | 289,667 | 415,814 | ...... | 705,606 | 22 |
| 1875.... | 350,721 | 572,726 | ...... | 923,447 | .. |

Included in the aggregate of 1860 were 88 Indians, and in that of 1870 124 Indians and 1 Chinaman. Of the total population in 1870, 343,902 were males and 361,704 females; 697,532 were of native and 8,074 of foreign birth. Of the natives, 678,708 were born in the state, 8,282 in North Carolina, 3,254 in Virginia and West Virginia, 2,874 in Georgia, and 945 in New York; 246,066 persons born in the state were living in other parts of the United States. Of the foreigners, 3,262 were born in Ireland, 2,754 in Germany, 617 in England, and 310 in Scotland. The density of population was 20·75 to a square mile. There were 151,105 families, with an average of 4·67 persons to each, and 143,485 dwellings, with an average of 4·92 to each. There were 233,915 persons from 5 to 18 years of age, 120,150 males from 18 to 45, and 146,614 male citizens 21 years old and upward. The increase of population from 1860 to 1870 was ·27 per cent. There were 265,892 persons 10 years old and over who could not read, and 290,379 unable to write; of the latter, 55,167 were white and 235,164 colored, 137,246 males and 153,085 females, and 179,145 were 21 years old and over. The number of paupers supported during the year ending June 1, 1870, was 2,343, at a cost of $224,805. Of the total number (2,071) receiving support at the end of the year, 965 were white and 1,106 colored. The number of persons convicted of crime during the year was 1,399. Of the 732 persons in prison at the end of the year, 148 were white and 584 colored. The state contained 451 blind, 212 deaf and dumb, 333 insane, and 465 idiotic. Of the total population (503,763) 10 years old and over, there were engaged in all occupations 263,301; in agriculture, 206,654, of whom 163,528 were laborers and 42,546 farmers and planters; in professional and personal services, 34,383, including 553 clergymen, 16,214 domestic servants, 10,654 laborers not specified, 387 lawyers, 789 physicians and surgeons, and 1,074 teachers not specified; in trade and transportation, 8,470; and in manufactures and mechanical and mining industries, 13,794. The total number of deaths from all causes was 7,380, being 1·05 per cent. of the entire population; from consumption, 657, there being 11·2 deaths from all causes to one from this disease. There were 255 deaths from cholera infantum, 273 from measles, 709 from pneumonia (or 10·4 deaths from all causes to one from this disease), 367 from intermittent and remittent fevers, 515 from enteric fever, and 537 from diarrhœa, dysentery, and enteritis.—The topography of the state resembles that of North Carolina and Georgia. The coast for about 100 m. inward is flat and sandy, with a light soil, covered by pitch-pine forests, traversed by sluggish streams, and interspersed with numerous swamps. This portion of the state is of alluvial formation. Beyond this plain is a belt of low sand hills called the middle country, which is moderately productive. West of

the middle country is a belt called the ridge, where the land rises abruptly, and thence continues to ascend, exhibiting beautiful alternations of hill and dale, till it terminates at the extreme N. W. part of the state in the Blue Ridge, the highest peak of which in South Carolina is Table mountain, 4,000 ft. above the Atlantic. The coast line extends from Little River inlet, in a S. W. direction, to the mouth of the Savannah river, about 200 m. The coast presents numerous inlets, bays, shallow sounds and lagoons, and a few good harbors. Winyaw bay, the easternmost harbor of any note, is 14 m. long and about 2 m. wide. Georgetown is at the head of this bay, to which vessels of light draught ascend. Passing S. W., Bull's bay is next in order, then Charleston harbor, St. Helena sound, and Beaufort harbor, or Port Royal entrance, besides a number of small inlets. Beaufort harbor, which admits vessels of 24 ft. draught, is one of the best in the southern states. Stono inlet, a few miles S. of Charleston, admits vessels drawing 9 or 10 ft. of water. St. Helena sound is a spacious opening 10 m. long and 3 m. broad. Small islands skirt the S. portion of the coast, shut off from the mainland by narrow channels, which afford inland steamboat communication between Charleston and Savannah. These islands are low and flat, and produce sea island cotton. Rice is also here produced in large quantities, and tropical fruits flourish.—Savannah river, which forms the boundary between South Carolina and Georgia, is formed by the confluence of the Tugaloo and Keowee, which rise in the mountains near the line of North Carolina and unite at Anderson, in the W. part of South Carolina; flowing thence in a S. S. E. direction 450 m., it empties into the Atlantic 18 m. below Savannah, near lat. 32° N. and lon. 81° W. The Savannah is navigable for large vessels to the city of Savannah, and for steamers of 150 tons to Augusta, 230 m. further, and by means of a canal round the falls at Augusta smaller boats ascend 150 m. further. The other principal rivers are the Great Pedee, the Santee, and the Edisto. The first, which rises in the Blue Ridge, flows E. S. E. and S. S. E. through North Carolina, where it is called the Yadkin, passes through the E. portion of South Carolina, receives the Black river and Lynch's creek on the right, and the Little Pedee and Waccamaw on the left, and empties into Winyaw bay. It is navigable for steamboats to Cheraw, a distance of about 150 m., above which navigation is obstructed by a fall. The Santee is formed by the junction of the Congaree and Wateree, which by their tributaries rise in the Blue Ridge (W. part of North Carolina), flow S., and unite in the central part of South Carolina; the stream thus formed, flowing upward of 120 m. in a S. E. direction, reaches the Atlantic by two mouths, North and South Santee, a few miles S. W. of Winyaw bay. The principal tributaries of the Congaree are the Saluda and Broad rivers. The Santee is navigable for its entire length, and its tributaries, the Wateree and Congaree, by aid of canals, are navigable for small boats nearly to the mountains, about 200 or 300 m. from the ocean. The Edisto and Combahee rise in the interior, and flowing S. reach the Atlantic near the southernmost point of the state. These streams are navigable for very small boats. The state is remarkably well watered, and almost every county abounds in good water power.—Geologically South Carolina is nearly equally divided between the primitive and the alluvial formations; the former prevailing in the upper portion, the latter along the coast. Among the beautiful granites of the state, the porphyritic granite of Camden and Buffalo creek, and the red granite near Columbia, are conspicuous. Of the syenites, those found in Abbeville, Fairfield, and Lexington counties are the most beautiful. The first resembles the Quincy granite, and the last is remarkable for its white feldspar, contrasting so strikingly with the black crystals of hornblende. White and variegated marbles are found in Spartanburg and Laurens. Gneiss, sufficiently slaty to be split into flagging stones, has been discovered in Pickens and in the lower part of York. Porcelain earth abounds through the primary regions, wherever the feldspathic granite is found in a state of disintegration. Soapstone of fine quality exists in several localities. Red and yellow ochres abound in Chesterfield co. Limestone is most abundant in Laurens and Spartanburg, while the white feldspathic sandstone, buhrstone, and flagstone are found in many of the upper counties. Manganese occurs in nearly every county N. of Columbia. Coal is found in Chesterfield and Marlboro. The gold-bearing rocks of the Atlantic slope extend through the N. W. corner of South Carolina, the metal being found in Abbeville, Edgefield, Lancaster, Pickens, Spartanburg, Union, and York counties. There are mines in Abbeville, Edgefield, and Union. The first mint deposits from South Carolina were $3,500 in 1827; the aggregate of such deposits to June 30, 1874, was $1,379,077. In several cases large nuggets of pure gold have been found, and gold-bearing veins have been successfully worked; but the largest quantities of gold have been obtained from surface washings. Copper occurs in some counties, while iron ore is found in the N. part of the state, above the King's mountain range, but no extensive efforts have been made to develop the deposits. Lead is found in Pickens co., bismuth in Chesterfield and Lancaster, and black lead in Spartanburg and Pickens. The limestones of the Blue Ridge may be used as fertilizers, while the richest deposits of bone phosphates on the continent, if not in the world, have recently been discovered in Charleston co., near the Ashley and Cooper rivers. These deposits underlie many square miles of surface

continuously, at a depth ranging from 6 in. to 12 ft., and exist in such quantities that from 500 to 1,000 tons underlie each acre. In fact, it seems there are no rocks in this section which are not phosphates. In 1870 it was officially estimated that $2,500,000 capital was invested in the business of converting the phosphates into forms available to agriculturists. The production of crude phosphates from 1867 to 1872 was valued at about $1,700,000.—Among the natural curiosities, the most prominent is Table mountain, 20 m. from Greenville, 4,000 ft. above the sea, which looms up perpendicularly on one of its faces 1,100 ft. above the surrounding country. "Cæsar's Head," a rock projection resembling a human skull, near Table mountain, is a place of summer resort. Glenn's Spring, the waters of which are impregnated with magnesia and sulphur, is a watering place of some note in Spartanburg. The falls of the Saluda among the mountains have a descent of from 300 to 400 ft., and the region presents much grand and picturesque scenery. Aiken has since the war become a place of resort for consumptives and other invalids, on account of its comparatively dry and equable climate. The mean temperature of Charleston (lat. 32° 45′, lon. 79° 57′) is: spring, 65·8°; summer, 80·6°; autumn, 68·1°; winter, 51·7°; year, 66·6°. The average rainfall is: spring, 8·60 inches; summer, 18·68; autumn, 11·61; winter, 9·40; year, 48·29. Prevailing wind, S. W. The following tables exhibit the result of observations taken at Aiken, Aiken co., 120 m. N. W. of Charleston, in lat. 33° 30′, lon. 81° 40′, and Gowdeysville, Union co., during the year 1870:

MEAN TEMPERATURE.

| PLACES. | Spring. | Summer. | Autumn. | Winter. | Year. |
|---|---|---|---|---|---|
| Aiken......... | 63·4° | 79·1° | 63·7° | 46·4° | 63·1¼° |
| Gowdeysville.. | 62·6 | 79·7 | 63·5 | 44·3 | 62·5 |

RAINFALL IN INCHES.

| PLACES. | Spring. | Summer. | Autumn. | Winter. | Year. |
|---|---|---|---|---|---|
| Aiken......... | 11·97 | 13·89 | 7·34 | 7·16 | 40·36 |
| Gowdeysville.. | 15·05 | 10·67 | 7·55 | 14·00 | 47·27 |

The maximum temperature at Aiken was 96° in July; minimum, 10° in December and 15° in February; maximum at Gowdeysville, 94° in July and August; minimum, 7° in December and 16° in February. Yellow fever occasionally occurs as an epidemic at Charleston.—South Carolina has very little waste land, and produces cotton, rice, tobacco, maize, oats, rye, barley, sweet and Irish potatoes, peas, beans, &c. The soil comprises six varieties: 1, tide swamp, appropriated to the culture of rice; 2, inland swamp, to rice, cotton, corn, peas, &c.; 3, salt marsh, to long cotton; 4, oak and pine, to long cotton, corn, potatoes, &c.; 5, oak and hickory, to short cotton, corn, &c.; 6, pine barren, to fruits, vegetables, &c. The pine lands, embracing about 6,000,000 acres, are perhaps the most neglected section of the state. The swamps, covering 2,000 sq. m. (1,280,000 acres), of inexhaustible fertility, are capable of drainage. The soil of much the larger portion of the state is clay, which, except in the immediate vicinity of the ocean, is almost the universal substratum. In the N. part of the state, particularly that portion bordering on the Blue Ridge, corn, wheat, oats, and barley flourish, while cotton is liable to suffer from early frosts. This region is also well adapted to the production of apples, pears, peaches, plums, grapes, and other small fruits. The central and lower portions of the state are better fitted to the culture of cotton, corn, and rice. Strawberries are abundant. The English walnut and Spanish mavson chestnut bear good crops, beginning to produce six or seven years after planting. On the sea islands grow the live oak and palmetto. In 1870 the state contained in farms 3,010,539 acres of improved land, 6,443,851 of woodland, and 2,650,890 of other unimproved land. The total number of farms was 51,889; average size, 233 acres. There were 10,286 containing from 3 to 10 acres, 9,146 from 10 to 20, 16,415 from 20 to 50, 8,148 from 50 to 100, 7,112 from 100 to 500, 465 from 500 to 1,000, and 418 of 1,000 and over. The cash value of farms was $44,808,763; of farming implements and machinery, $2,282,946; total amount of wages paid during the year, including value of board, $7,404,297; total (estimated) value of all farm productions, including betterments and additions to stock, $41,909,402; orchard products, $47,960; produce of market gardens, $127,459; forest products, $167,253; home manufactures, $312,191; animals slaughtered or sold for slaughter, $2,507,149; value of live stock, $12,443,510. There were 44,105 horses, 41,327 mules and asses, 98,693 milch cows, 17,685 working oxen, 132,925 other cattle, 124,594 sheep, and 395,999 swine. The productions were 317,700 bushels of spring and 465,910 of winter wheat, 36,165 of rye, 7,614,207 of Indian corn, 613,593 of oats, 4,752 of barley, 460,378 of peas and beans, 83,252 of Irish and 1,342,165 of sweet potatoes, 5,830 of clover seed, 10,665 tons of hay, 224,500 bales of cotton, 32,304,825 lbs. of rice, 34,805 of tobacco, 1,461,980 of butter, 194,253 of honey, 11,404 of wax, 1,055 hogsheads of cane sugar, 13,179 gallons of wine, 241,815 of milk sold, 436,882 of cane and 183,585 of sorghum molasses. The production of cotton in 1873–'4 amounted to 438,194 bales of 468 lbs. each, including 8,759 bales of sea island.—The total number of manufacturing establishments in 1870 was 1,584, having 210 steam engines of 4,537 horse power, and 700 water wheels of 10,395 horse power, and employing 8,141 hands, of whom 7,099 were males above 16, 578 females above 15, and 464 youth. The capital invested amounted to $5,400,418; wages paid during the year, $1,543,715; value of materials used, $5,855,736; of products, $9,858,981. The leading industries were as follows:

| INDUSTRIES. | No. of establishments. | No. of hands employed. | Capital. | Value of products. |
|---|---|---|---|---|
| Blacksmithing | 147 | 845 | $39,960 | $151,329 |
| Bread, crackers, &c. | 17 | 71 | 36,200 | 142,045 |
| Carpentering and building | 64 | 481 | 286,135 | 813,850 |
| Carriages and wagons | 77 | 288 | 81,820 | 186,114 |
| Cotton goods | 12 | 1,123 | 1,337,000 | 1,529,937 |
| Fertilizers | 2 | 825 | 350,000 | 425,000 |
| Flouring and grist-mill products | 624 | 1,138 | 835,814 | 3,180,247 |
| Iron, forged and rolled | 2 | 15 | 20,000 | 22,190 |
| " castings | 7 | 85 | 64,251 | 119,750 |
| Leather, tanned | 34 | 72 | 24,125 | 85,778 |
| " curried | 31 | 55 | 16,075 | 80,247 |
| Lumber, planed | 2 | 19 | 19,000 | 35,000 |
| " sawed | 227 | 1,212 | 583,425 | 1,197,005 |
| Machinery | 21 | 415 | 443,702 | 496,425 |
| Oil, cotton-seed | 1 | 24 | 40,000 | 27,200 |
| Paper, printing | 2 | 43 | 109,000 | 79,000 |
| Printing and publishing, newspapers | 11 | 164 | 102,550 | 237,930 |
| Printing, job | 2 | 18 | 27,000 | 19,225 |
| Ship building, repairing, and ship materials | 7 | 27 | 26,800 | 45,650 |
| Tar and turpentine | 54 | 876 | 205,425 | 774,077 |
| Tin, copper, and sheet-iron ware | 20 | 63 | 37,650 | 87,294 |
| Wool-carding and cloth-dressing | 12 | 40 | 17,200 | 21,259 |
| Woollen goods | 3 | 13 | 8,700 | 13,200 |

The number of cotton mills in 1874 was 18, having 1,238 looms and 62,872 spindles; the amount of cotton used during the year was 7,134,558 lbs. South Carolina has three United States customs districts, indicated in the following statement of foreign commerce for the year ending June 30, 1875, with the number of vessels registered, enrolled, and licensed:

| PORTS OF ENTRY. | Imports. | Exports. | Registered, &c. | |
|---|---|---|---|---|
| | | | Vessels. | Tons. |
| Beaufort | $122,318 | $1,047,257 | 16 | 2,104 |
| Charleston | 680,343 | 19,655,966 | 185 | 12,051 |
| Georgetown | ...... | 17,635 | 25 | 3,288 |
| Total | $802,661 | $20,720,858 | 226 | 17,443 |

The chief article of export is cotton. During the fiscal year 259,053 bales were exported from Charleston, valued at $17,930,603, besides 6,357 bales of sea island, valued at $779,346. The shipments of cotton, rice, naval stores, phosphates, and lumber to ports of the United States constitute an extensive trade. The amount of shipping in 1875 was as follows:

| DISTRICTS. | FOREIGN PORTS. | | | | COASTWISE. | | | |
|---|---|---|---|---|---|---|---|---|
| | ENTERED. | | CLEARED. | | ENTERED. | | CLEARED. | |
| | Vessels. | Tons. | Vessels. | Tons. | Vessels. | Tons. | Vessels. | Tons. |
| Beaufort | 80 | 32,862 | 88 | 39,516 | 44 | 25,852 | 27 | 17,875 |
| Charleston | 236 | 102,023 | 268 | 119,274 | 504 | 382,018 | 461 | 328,266 |
| Georgetown | 1 | 174 | 7 | 2,394 | 55 | 14,356 | 6 | 1,408 |
| Total | 317 | 135,059 | 363 | 161,184 | 603 | 422,226 | 494 | 347,549 |

The state had 204 m. of railroad in 1845, 759 in 1855, 1,007 in 1865, and 1,298 in 1875. The following table shows the railroads lying wholly or partly within the state:

| NAMES OF CORPORATIONS. | TERMINI. | | Miles in operation in South Carolina in 1875. | Total length of line when different from preceding. |
|---|---|---|---|---|
| | FROM | TO | | |
| Atlanta and Richmond Air Line | Atlanta, Ga | Charlotte, N. C. | 125 | 265 |
| Charlotte, Columbia, and Augusta | Charlotte, N. C. | Augusta, Ga | 183 | 195 |
| Cheraw and Darlington | Florence | Cheraw | 40 | .... |
| Chester and Lenoir | Chester | Yorkville | 22 | .... |
| Cheraw and Salisbury | Cheraw | Salisbury, N. C. | 12 | 80 |
| Greenville and Columbia | Greenville | Columbia | 143 | .... |
| Branch | Cokesbury | Abbeville | 12 | .... |
| Leased, Blue Ridge | Belton | Walhalla | 43 | .... |
| Northeastern | Charleston | Florence | 102 | .... |
| Port Royal | Port Royal Harbor | Augusta, Ga | 111 | .... |
| Savannah and Charleston | Savannah, Ga | Charleston | 96 | 104 |
| South Carolina | Charleston | Augusta, Ga | 111 | .... |
| Branches | Branchville | Columbia | 38 | .... |
| | Kingsville | Camden | 68 | .... |
| Spartanburg and Union | Alston | Spartanburg | 68 | .... |
| Wilmington, Columbia, and Augusta | Wilmington, N. C | Columbia | 124 | 189 |

The Santee canal, 22 m. long, connects Charleston, through Cooper river, with the Santee. There are also several short canals, having an aggregate length of about 30 m. At the beginning of 1875 there were 12 national banks in operation, with a capital stock of $3,135,000; circulation, $2,167,420; circulation per capita, $3 07; ratio of circulation to the wealth of the state, 1 per cent.; to bank capital, 69·1 per cent.—The government is administered under the constitution adopted in 1868, which provides that slavery shall never exist in the state; that every citizen owes paramount allegiance to the United States; that the state shall ever remain a member of the American Union; no property qualification shall be necessary to eligibility to office; distinctions on account of race or color shall be prohibited, and all citizens shall enjoy all common public, legal, and political privileges; no debt contracted by

the state in behalf of the rebellion shall ever be paid; presidential electors shall be elected by the people; the distinction between actions at law and suits in equity is abolished. The right of suffrage is bestowed upon every male citizen of the United States, 21 years old and upward, who has resided in the state one year, and in the county where he shall offer to vote 60 days preceding the election. Elections are by ballot, and a plurality only of the votes cast is necessary to a choice. Qualified electors, who acknowledge the existence of the Supreme Being, are entitled to hold office, with unimportant exceptions. The legislative power is vested in a general assembly, consisting of a senate composed of one member from each county except Charleston, which elects two senators, and a house of 124 representatives apportioned among the counties according to population, each county having at least one. The senators hold office for four years and the representatives for two. They receive $6 a day during the session, and 20 cents a mile for travel to and from the capital. The sessions of the legislature are annual, beginning on the fourth Tuesday of November. The state election is held on the third Wednesday of October in even years. The executive power is vested in a governor (annual salary $3,500 with a furnished residence) and a lieutenant governor ($2,500), *ex officio* president of the senate, who hold office for two years; a comptroller general ($3,000), treasurer ($2,500), secretary of state ($3,000), and attorney general ($3,000), who hold office for four years; a superintendent of education ($2,500), and an adjutant and inspector general ($2,500). These officers are elected by the people. The governor and lieutenant governor must have been two years resident in the state. The governor's veto may be overcome by a two-thirds vote of the legislature. The judicial power is vested in a supreme court, circuit courts (each of which is subdivided into a court of common pleas with civil jurisdiction, and a court of general sessions with criminal jurisdiction), probate courts, and courts of justices of the peace. The supreme court consists of a chief and two associate justices, elected by joint vote of the two houses of the legislature for six years. The chief justice receives an annual salary of $4,000, and the associates $3,500 each. The state is divided into eight circuits, for each of which a judge is elected by joint vote of the legislature for four years; each receives a salary of $3,500 a year. The supreme court has in general appellate jurisdiction only. The courts of common pleas have exclusive jurisdiction in matters of divorce, exclusive original jurisdiction in civil cases not cognizable by justices of the peace, and appellate jurisdiction in cases provided for by law. The courts of sessions have exclusive jurisdiction in criminal cases not otherwise provided for by law. A judge of probate is elected for each county by the people for two years. Trial justices appointed by the governor have jurisdiction of civil cases where the amount involved does not exceed $100, and of criminal proceedings for minor offences. A homestead not exceeding $1,000 in value is exempt from sale under execution, to every head of a family. A poll tax not exceeding $1 may be levied for school purposes. Provision is made for taking decennial censuses, beginning in 1875. The property of a married woman is not liable for the debts of her husband, and she may deal with it in all respects as if unmarried. Before the adoption of the present constitution, divorce was unknown in the state. Divorces are now granted for adultery or desertion for two years; and the one deserting may obtain a divorce if the desertion is justified by cruel treatment, or by neglect of the husband to provide maintenance. The death penalty is abolished, except in cases of wilful murder. Arson and rape are punishable by imprisonment for life or for a period not less than 10 years; the penalty of manslaughter and of burglary is imprisonment for a period not exceeding 30 years. The legal rate of interest, in the absence of agreement, is 7 per cent., but any rate may be contracted for. A convention to revise the constitution may be called by vote of the people, the question having been submitted to them by a two-thirds vote of each house of the legislature. Specific amendments must be proposed by two thirds of each house, voted for by a majority of the people at the next general election, and afterward ratified by a two-thirds vote of each house of the next general assembly. The state has two senators and five representatives in congress, and is therefore entitled to seven votes in the electoral college.—The state debt on Nov. 1, 1874, was reported at $17,017,651, including $9,540,750 bonded debt, $2,679,293 floating debt, and $4,797,608 contingent liabilities. Not included in this statement are bonds to the amount of $5,965,000 issued under the act of March 23, 1869, for the conversion of state securities, which have been declared by the legislature to have been issued without authority, and to be therefore null and void; but the statement includes interest on these bonds, amounting to $894,750, which it is asserted is illegal and should be deducted from the state's liabilities. The bonded debt falls due at different dates between 1877 and 1893; the rate of interest on most of it is 6 per cent. The floating debt consists of unpaid appropriations and over-due interest. The contingent liabilities were created by the indorsement by the state of the following railroad bonds, the state being secured by mortgages on the roads:

| | |
|---|---|
| South Carolina railroad | $2,093,312 |
| Northeastern | 92,000 |
| Charleston and Savannah | 505,000 |
| Savannah and Charleston | 245,750 |
| Laurens | 75,000 |
| Spartanburg and Union | 350,000 |
| Greenville and Columbia | 1,436,546 |
| Total | $4,797,608 |

The receipts from all sources during the year ending Oct. 31, 1874, amounted to $1,712,268, and the expenditures to $1,599,232. The assessed valuation of taxable property in 1874 was $141,624,952, viz.: real estate, $87,794,305; personal property, $43,944,070; railroad property, $9,886,577. The total valuation in 1873 was $176,956,502. The rate of the tax levy for state purposes in 1874 was 10$\frac{23}{60}$ mills. —The constitution of 1868 provides for a uniform system of free common schools to be supported by a tax on property and polls, and for the establishment of a state normal school, a state reform school, a state university, and educational institutions for the deaf and dumb and the blind. It also declares that all public schools, colleges, and universities, supported wholly or partly by the public funds, shall be free to all the children of the state without regard to color; but separate schools are generally provided. Provision was made for the compulsory attendance upon public or private schools of all children between the ages of 6 and 16 years, but no law for this purpose has yet (1876) been passed by the legislature. The state superintendent, who is elected by the people for four years, has general supervision of the public schools. The state board of education consists of the superintendent and the several county school commissioners. There are 32 of the latter officers (one in each county), elected for two years by the people, at an annual salary of $1,000, except in Charleston county, where the salary is $1,200. Each county has a board of school examiners, composed of the commissioner and two members appointed by him; their chief duties are the examination of teachers and the appointment of district trustees. There are no graded schools except in Charleston. The sources of school revenue are: 1, state school tax; 2, poll tax; 3, district taxes. The common school statistics for 1873–'4 were as follows:

| | |
|---|---|
| School population, 6 to 16 years of age, inclusive | 230,102 |
| White males | 43,474 |
| " females | 41,501 |
| Colored males | 73,442 |
| " females | 71,685 |
| Number of school districts | 429 |
| " of schools | 2,353 |
| School attendance | 104,738 |
| White | 45,774 |
| Colored | 58,964 |
| Number of teachers | 2,627 |
| Males | 1,625 |
| Females | 1,002 |
| White | 1,772 |
| Colored | 855 |
| Average monthly wages, males | $32 73 |
| " " " females | $30 48 |
| Average length of schools | 5 months |
| Number of school houses | 2,228 |
| Value of " " | $274,808 |
| Expenditures for schools | $448,251 |
| Total school revenue | $512,924 |
| From state tax | $300,000 |
| " poll " | $59,514 |
| " local " | $110,735 |
| " other sources | $42,675 |
| Net school revenue | $483,145 |

The state normal school was opened in Columbia in September, 1874, with two instructors and 32 students. The course of study occupies two years. In 1874 there were ten teachers' institutes held in eight counties. The university of South Carolina, in Columbia, has preparatory, academical, law, and medical departments, which are open to white and colored pupils. In 1874–'5 there were 166 students, viz.: 17 in the law, 4 in the medical, and 79 in the preparatory school, 64 in the academical department, and 2 in a special course. State scholarships were established in the university in 1874, and $6,400 appropriated for that purpose. In 1874–'5 57 students were holding state scholarships. The state appropriations for the university during the year ending Oct. 31, 1874, amounted to $41,750. The library of the university in 1875 had 30,000 volumes. Claflin university, at Orangeburg, was opened in 1870 for the education of colored persons of both sexes. In 1872 the state college of agriculture and the mechanic arts was established in connection with this institution, which was then named "Claflin University and South Carolina Agricultural College and Mechanical Institute." The departments which have been organized are: 1, common English; 2, classical preparatory and higher English; 3, agricultural and scientific. In 1874–'5 there were 5 instructors and 188 students, including 65 pursuing scientific, agricultural, and military studies. Furman university (Baptist), opened in 1851 at Greenville, in 1874–'5 had 5 professors and 55 students in the collegiate department. The institution has an endowment of $200,000, contributed by the Baptists of South Carolina; and for ten years from Jan. 1, 1876, tuition is to be free. Newberry college (Lutheran), at Walhalla, Oconee co., opened in 1858, in 1874–'5 had 6 instructors and 101 pupils, including 70 in the preparatory department. Wofford college (Methodist Episcopal church, South), opened in 1853, is at Spartanburg Court House; it has collegiate and preparatory departments, and in 1874–'5 there were 7 instructors. The principal institutions for the higher instruction of women are Columbia female college in Columbia, which in 1874–'5 had 7 teachers and 97 students; Due West female college, at Due West, Abbeville co., with 9 teachers and 113 pupils; the Greenville Baptist female college, at Greenville, with 10 teachers and 117 pupils; and the Williamston female college, at Williamston, with 8 instructors and 119 pupils. The Southern Baptist theological seminary at Greenville, established in 1859, in 1874–'5 had 5 professors and 66 students. The theological seminary of the general assembly of the Presbyterian church in the United States was opened at Lexington, Ga., in 1829, and was removed to Columbia, its present seat, in 1830. It has a library of about 19,000 volumes, and endowments, not including buildings and library, amounting to $164,000. In 1873–'4 there were 5 instructors and 57 students. The medical college of the state of South Carolina, in Charleston, was

opened in 1832, and in 1875 had 8 instructors and 60 students.—The state institution for the education of the deaf, dumb, and blind is at Cedar Springs in Spartanburg co.; but it is now (1876) suspended. The state orphan asylum, in Columbia, had in 1874 an average of 80 inmates, of whom 38 were girls. The legislature appropriated $25,000 for this institution in 1874; the expenditures amounted to $18,900. The state lunatic asylum, in Columbia, opened in 1828, had an average of 312 patients during the year ending Oct. 31, 1874, and 311 at the end of the year. The average annual cost of maintenance is $250 for each patient; $65,000 was appropriated for it in 1874, and the expenditures were $71,590. The state penitentiary, in Columbia, had in 1874 an average of 250 prisoners, who were chiefly employed upon public buildings on account of the state; their earnings amounted to $23,774. The expenses of the institution were $69,838; the state appropriation was $50,000. Religious exercises are held on Sunday. There is a day school for all convicts, and a reformatory school for those under 18 years of age, who are kept separate from the other convicts.—The total number of libraries reported by the census of 1870 was 1,663, containing 546,244 volumes. Of these, 922 with 397,020 volumes were private, and 741 with 149,224 volumes other than private; among the latter were one state library, with 2,700 volumes; 3 court and law, 6,324; 4 school, college, &c., 20,800; 647 Sunday school, 93,200; 84 church, 25,100; and 2 circulating, 1,100. The total number of newspapers and periodicals was 55, having an aggregate circulation of 80,900 and issuing annually 8,901,400 copies. Of these, 5 were daily, with an aggregate circulation of 16,100; 4 tri-weekly, circulation 9,600; 42 weekly, 44,000; 3 monthly, 10,000; and 1 quarterly, 1,200. In 1875 there were reported 7 daily, 3 tri-weekly, 3 semi-weekly, 62 weekly, 1 bi-weekly, 2 semi-monthly, 4 monthly, and 2 quarterly; total, 84. The total number of religious organizations in 1870 was 1,457, having 1,308 edifices, with 491,425 sittings and property valued at $3,276,982. The denominations were represented as follows:

| DENOMINATIONS. | Organizations. | Edifices. | Sittings. | Property. |
|---|---|---|---|---|
| Baptist, regular | 518 | 466 | 190,750 | $688,882 |
| " other | 5 | 5 | 800 | 1,600 |
| Christian | 2 | 2 | 200 | 400 |
| Congregational | 1 | 1 | 300 | 10,000 |
| Episcopal, Protestant | 83 | 81 | 35,350 | 729,600 |
| Friends | 1 | 1 | 300 | 500 |
| Jewish | 3 | 3 | 900 | 91,200 |
| Huguenot | 1 | 1 | 400 | 10,000 |
| Lutheran | 49 | 44 | 17,900 | 137,450 |
| Methodist | 611 | 532 | 164,050 | 652,100 |
| Presbyterian, regular | 148 | 136 | 61,450 | 537,900 |
| " other | 16 | 17 | 5,650 | 33,500 |
| Reformed church in America (late Dutch Reformed) | 2 | 2 | 300 | 4,000 |
| Roman Catholic | 12 | 13 | 10,775 | 271,500 |
| Unitarian | 1 | 1 | 750 | 20,000 |
| Universalist | 3 | 2 | 850 | 58,350 |
| Unknown (local mission) | 1 | 1 | 700 | 10,000 |

—The first attempt to colonize the territory now comprised in South Carolina was made by Jean Ribault, a Frenchman. (See RIBAULT.) The province of Carolina was created by Charles II. in 1663. (See NORTH CAROLINA.) The first permanent settlement in South Carolina was made on the banks of the Ashley river in 1670 by English colonists, who removed in 1680 to the present site of Charleston. Under the name of Carolina, both the present states of North and South Carolina were held as a proprietary government, nominally under the celebrated model constitution prepared by John Locke, till July, 1729, when the king bought out the proprietors, and formed the Carolinas into two royal colonies. In 1685 a large number of French Huguenots settled in South Carolina, and subsequently there were considerable settlements of Swiss, Irish, and German emigrants. The colony at various times suffered severely from Indian depredations, and with Georgia was engaged under Oglethorpe in a contest with the Spanish settlements in Florida. South Carolina was the scene of severe warfare during the revolutionary struggle, hotly contested battles being fought at Fort Moultrie, Charleston, Camden, King's Mountain, Cowpens, Eutaw Springs, &c. The British held the country for the greater part of the years 1780 and 1781. The battle of Eutaw Springs, September, 1781, between Gen. Greene and Col. Stuart, in which both sides claimed the victory, was the last engagement of any importance during the revolution. A state constitution was first adopted on March 26, 1776; the constitution of the United States was ratified by South Carolina on May 23, 1788. Immediately after the presidential election of 1832, a convention of the people of South Carolina was called to meet at Columbia, to take action on the high tariff of 1828 and 1832. The convention met on Nov. 19, unanimously adopted the "nullification ordinance," which pronounced the tariff "null, void, and no law, nor binding on this state, its officers and citizens," and prohibited the payment of duties on imports imposed by that law within the state after Feb. 1 ensuing. The ordinance contemplated an act of the legislature nullifying the tariff, and declared that no appeal should be made to the supreme court of the United States against the validity of such act. It was also declared that should the general government attempt to enforce the law thus nullified, or to interfere with the foreign commerce of the state, the people of South Carolina would "hold themselves absolved from all further obligation to maintain or preserve their political connection with the people of the other states." This action was approved by the governor, Robert Y. Hayne, in his message to the legislature, and measures were adopted by that body to give practical effect to the ordinance. In view of the threatened emergency, President Jackson ordered Gen. Scott to Charles-

ton for the purpose of "superintending the safety of the ports of the United States in that vicinity," and soon after the meeting of congress in December issued a proclamation in which he held that nullification was treason and should be punished as such. During the session of this congress the compromise tariff was passed, which being acceptable to South Carolina, the course threatened by that state was not pursued. In April, 1860, the South Carolina delegates to the national democratic convention in session at Charleston withdrew from that body because the convention did not expressly deny in its platform "the power either of the federal government, or its agent, the territorial government, to abolish or legislate against property in slaves by either direct or indirect legislation." South Carolina was the first of the southern states to institute active measures for withdrawing from the Union on the election of Mr. Lincoln, and the first to pass an ordinance of secession. On Nov. 7, 1860, an act was passed by the legislature calling a state convention. On the same day the United States officials in Charleston resigned, and on the 10th the South Carolina senators withdrew from the United States senate. An election of delegates having been held on Dec. 6, the convention assembled in Charleston on the 18th, and passed the ordinance of secession on the 20th without a dissenting vote. Commissioners were appointed to go to Washington to treat with President Buchanan for the possession of federal property within the limits of South Carolina, while others were sent to the slaveholding states to invite their coöperation in the formation of a southern confederacy. On the 24th the representatives in congress withdrew from that body, and on the same day Gov. Pickens proclaimed the dissolution of the union between South Carolina and the other states. On the 27th Fort Moultrie and Castle Pinckney were seized by the state. The bombardment and capture of Fort Sumter, April 12, 13, by Gen. Beauregard (see SUMTER, FORT), was the beginning of open hostilities, and caused great excitement throughout the country. The ports of the seceded states were declared blockaded by President Lincoln on April 19. Hilton Head and Bay Point were captured on Nov. 7 by an expedition under Admiral Du Pont and Gen. T. W. Sherman. On April 7, 1863, Admiral Du Pont made an unsuccessful attempt to reduce the defences of Charleston harbor, losing one of his vessels in the engagement. A land attack was made in July by Gen. Q. A. Gillmore, who took possession of Morris island, but was repulsed with great loss in an assault upon Fort Wagner. That work was reduced by bombardment, Sept. 7, and shells were thrown into the city itself. In the latter part of January, 1865, Gen. W. T. Sherman's army began its march from Savannah through South Carolina, having Goldsboro, N. C., as an objective point, and threatening Charleston and Augusta at the same time. Columbia was surrendered on Feb. 17, and Charleston and all its defences were evacuated on the same day. (See CHARLESTON, and COLUMBIA.) Gen. Sherman, resuming his march from Columbia, and destroying railroads, bridges, &c., reached Cheraw on the Great Pedee, March 3, whence he moved to Fayetteville, N. C. B. F. Perry was appointed provisional governor of South Carolina, June 30, 1865. On Sept. 4 delegates were chosen to a convention, which assembled in Columbia, Sept. 13, repealed the ordinance of secession, and declared slavery abolished. James L. Orr was chosen governor at a general election held on Oct. 18. At the same time a legislature was elected, which met before the close of the month. Gov. Orr assumed the duties of his office on Nov. 29, but it was not till Dec. 25 that the provisional governor was relieved and the authority in the state restored to the officers elected by the people. This government continued in force until supplanted by the military government provided by congress in March, 1867, when Gen. Sickles was appointed to the command of the second military district, embracing North and South Carolina. He was succeeded in the beginning of September by Gen. Canby. A registration of voters was now held, preliminary to an election to ascertain the will of the people in reference to calling a state convention to frame a constitution and civil government, and 78,982 colored and 46,346 white voters were registered. At the election, held on Nov. 19 and 20, 68,876 colored and 130 white persons voted for a convention, and 2,081 whites against it. Of the delegates chosen, 34 were white and 63 colored. The convention assembled on Jan. 14, 1868, and adopted a constitution, which was ratified by the people, April 14, 15, and 16, by a vote of 70,758 to 27,288. At the same time state officers, members of the legislature (of whom 72 were white and 85 colored), and representatives to congress were chosen. The legislature assembled on July 6, and on the 9th Gov. Scott was inaugurated. The state became entitled to representation in congress by the ratification (108 to 10) of the fourteenth amendment to the federal constitution, and reconstruction was practically completed by the withdrawal of the military authorities on the 13th. The fifteenth amendment to the federal constitution was ratified by the legislature on March 11, 1869, by a vote of 18 to 1 in the senate and 88 to 3 in the house. At the presidential election in 1868, 62,916 votes were cast for Grant (republican) and 45,237 for Seymour (democrat). This was the first time in the history of the state that the people had voted for president and vice president; previously the presidential electors had been chosen by the legislature. During 1868 and subsequently disorders alleged to have been committed by masked outlaws called "Ku-klux" were reported in this state, espe-

cially in the N. W. counties. In the latter part of 1871 and the beginning of 1872 numerous arrests were made under an act of congress for the suppression of these outrages, and many persons were convicted in the United States courts and punished.

**SOUTHCOTT, Joanna**, an English religious enthusiast, born at Gittisham, Devonshire, about 1750, died in London, Dec. 27, 1814. Until nearly 40 years of age she was a domestic servant, and for some years was a member of the established church, but shortly before promulgating her peculiar notions she united with the Wesleyans. In 1792 she began to attract attention by claiming supernatural powers and narrating remarkable revelations made to her in dreams. She published prophecies and warnings in extravagant prose and rude doggerel, challenged the clergy to investigation and discussion, and labored with so much energy and zeal that her sect at the time of her death was estimated at 100,000 persons. When upward of 60 years old she announced that she was pregnant and would give birth to a second Shiloh. Shortly before her death she expressed the conviction that "if she was deceived, she had at all events been misled by some spirit, good or evil." A *post mortem* examination disclosed the fact that dropsy was mistaken by her for pregnancy. Before her death a communication, said to be from her, directed her followers to hold no more meetings until after the birth of Shiloh. Little was heard of the sect till 1825, when a man named Twort professed to be the Shiloh promised. One George Turner made a like claim. In the census of 1851 there were reported in England four congregations of her followers. John Wroe became their leader in 1822, and in 1857 opened a mansion at Wenthorp for a community of Southcottians.

**SOUTHERN, Thomas**, a British dramatist, born at Oxmantown, Ireland, about 1660, died in Westminster, May 26, 1746. After spending two years at Trinity college, Dublin, he entered in 1678 the Middle Temple, London, but soon gave up the law for literature. Of the ten plays which he wrote, the best known are "Isabella, or the Fatal Marriage," in which Mrs. Siddons won her first laurels, and "Oronooko," in which he denounced slavery and the slave trade. A complete edition of his works appeared in 1774 (3 vols. 12mo).

**SOUTHERNWOOD.** See Artemisia.

**SOUTHEY. I. Robert**, an English author, born in Bristol, Aug. 12, 1774, died at Greta hall, near Keswick, March 21, 1843. In his 14th year he was placed at Westminster school, the expenses being borne by a maternal uncle. For publishing in "The Flagellant," a periodical started by him and his associates, a satirical article on corporal punishment, he was expelled in 1792. He entered Balliol college, Oxford, in January, 1793, accepted with enthusiasm the liberal ideas to which the French revolution had given currency, and began his career of unparalleled industry as a man of letters. He wrote in 1793 the dramatic poem of "Wat Tyler," first published surreptitiously in 1817, which was assailed in the house of commons as seditious. With Coleridge and Lovell he formed the abortive plan of a pantisocracy, or perfect society, on the banks of the Susquehanna. He left the university in 1794, published in connection with Lovell a volume of "Poems" (1794), and received from Cottle 50 guineas for his "Joan of Arc" (1795), an epic poem, which was favorably received. In 1795-'6 he spent six months with his uncle in the Peninsula, and published "Letters written during a Short Residence in Spain and Portugal" (1797). In 1797 he went to London to study law, but soon took lodgings for most of the time in the country, and continued his literary pursuits. He was the editor and principal writer of the "Annual Anthology" for 1799 and 1800. His health failing, he again visited Portugal in 1800, and collected materials for a history of that country. For his second epic poem, "Thalaba, the Destroyer" (2 vols. 12mo, 1801), he received 100 guineas. The post of secretary to the chancellor of the exchequer for Ireland was offered to him with a salary of £350, but he soon resigned what he termed "a foolish office and a good salary." In 1804 he settled at Greta, near Keswick, where Coleridge was living, and about 14 m. from Wordsworth at Grasmere. From this time he appears in his writings as an uncompromising monarchist and churchman, and his life was marked by untiring and cheerful labor, and by repeated acts of generosity. He received as permanent inmates of his house the wives of Lovell and Coleridge, sisters of his own wife, assisted in editing the works of Chatterton for the benefit of the sister of that poet, and extended his kindness to several unfortunate poets, among whom was Henry Kirke White, whose "Remains" he edited with a biography. He visited and formed a life-long intimacy with Sir Walter Scott in 1805; became an occasional contributor to the "Quarterly Review;" received in 1807 a pension of £160; undertook in 1809 the historical department of the "Edinburgh Annual Register;" was appointed poet laureate in 1813; received the degree of LL. D. from the university of Oxford in 1821; visited Holland in 1825, and remained three weeks at Leyden in the house of Bilderdijk; declined the offer of a baronetcy in 1835, but accepted an addition of £300 to his pension; and made a tour in Normandy and Brittany in 1837. His intense and protracted activity had now resulted in mental prostration; his memory failed, and his recognition of time and place gave way, and during the last year there was an utter extinction of his faculties. He left at his death one of the most remarkable private libraries in England, which was sold by auction in London.—There is scarcely a department of literature in which Southey did

not engage. His three best poems are "Thalaba, the Destroyer" (1801), an Arabian tale, "The Curse of Kehama" (1810), founded upon fables of the Hindoo mythology; and "Roderick, the Last of the Goths" (1814), the subject of which is the fall of the Gothic dominion in Spain. "Madoc," one of his longer poems, is founded on traditions of Welsh voyages to America. His principal prose works, besides his translations of "Amadis de Gaul" and the "Chronicle of the Cid" from the Spanish, and of "Palmerin of England" from the Portuguese, are: "History of Brazil" (3 vols. 4to, 1810–'19); "Life of Nelson" (2 vols. 8vo, 1813); "Life of John Wesley" (2 vols., 1820); "History of the Peninsular War" (3 vols. 4to, 1822–'32); "Book of the Church" (2 vols. 8vo, 1824); "Sir Thomas More, or Colloquies on the Progress and Prospects of Society" (2 vols., 1829); "Life of John Bunyan" (1830); "Essays, Moral and Political" (2 vols., 1832); and "The Doctor" (7 vols., 1834–'7; best ed., 1 vol., London, 1856). His curious erudition is happily shown in the last, and also in his "Commonplace Book," of which four volumes were edited after his death by his son-in-law, the Rev. J. W. Warter. Southey collected his poetical works (10 vols., 1837–'8), and Mr. Warter has published four volumes of his "Letters" (1856). His life was written by his son, the Rev. C. C. Southey, in which is interwoven his correspondence with many distinguished men of his time (6 vols., 1849–'50). **II. Caroline Anne Bowles,** second wife of the preceding, born at Buckland, Hampshire, Dec. 6, 1787, died July 20, 1854. She was the only child of Capt. Charles Bowles, a retired officer. She published "Ellen Fitz-Arthur," a poem (1820); "The Widow's Tale, and other Poems" (1822); "Solitary Hours, Prose and Verse" (1826); and "Chapters on Churchyards" (2 vols., 1829). In 1839 she married Robert Southey, between whom and herself a long friendship had existed. They had planned to write many works together; but only two or three fragmentary volumes appeared as their joint production.

**SOUTH SEA SCHEME** (often called the South sea bubble), a financial delusion of the early part of the 18th century. In 1711 Robert Harley, earl of Oxford, then lord treasurer, proposed to fund a floating debt of about £10,000,000, the interest, about £600,000, to be secured by rendering permanent the duties upon wines, tobacco, wrought silks, &c. Purchasers of this fund were to become also shareholders in the South sea company, a corporation to have the monopoly of trade with Spanish South America, a part of the capital stock of which was to be the new fund. After the peace of Utrecht, however, Spain refused to open her commerce to England, and the privileges of the South sea company became worthless. As many men of wealth were among its shareholders and directors, the corporation continued to flourish as a monetary institution. The bad success of its trading operations was concealed, and accounts of the riches of Chili and Peru, together with false reports of intended concessions by the king of Spain, were skilfully used to increase its credit. The breaking out of the Spanish war in 1718 did not shake the popular confidence in its promises. The stock of the company was in great request, and the directors determined to enter upon the same career that John Law was then running in France. In April, 1720, parliament by large majorities in both houses accepted their plan for paying the national debt, that of the bank of England being rejected. Walpole was almost the only eminent man who protested against the measure. The South sea company took upon itself the whole debt of the state, £30,981,712, in consideration of 5 per cent. per annum secured to them for four years, after that to be redeemable by the government, and the interest to be 4 per cent. Hereupon a frenzy of speculation seized the whole nation. Shares of the South sea company, which at the passing of the bill sold at £300, soon began to rise rapidly; and an enormous traffic in them sprung up, in which all classes engaged. By May 29 two thirds of the government annuitants had exchanged the securities of the government for those of the company. Not even the collapse of Law's scheme at the end of May checked the popular infatuation; South sea stock kept on rising until early in August, when it reached its maximum, £1,000. Soon afterward it became known that Sir John Blunt, the chairman, and some others had sold out, and the stock began to fall. Toward the close of September, in spite of great efforts both of the government and of the bank of England to save its credit, the company stopped payment, and thousands were beggared. An investigation ordered by parliament disclosed much fraud and corruption, in which many prominent persons were implicated. Some of the directors were imprisoned, and all of them were fined to an aggregate amount of over £2,000,000 for the benefit of the stockholders. A great part of the valid assets of the company was also distributed among them, yielding a dividend of about 33 per cent.—See Coxe's "Memoirs of Walpole" (2 vols., 1798), and "Memoirs of Extraordinary Popular Delusions," by Charles Mackay (London, 1850).

**SOUTHWELL,** or **Sotwell, Nathaniel,** an English scholar, born in the county of Norfolk about 1600, died in Rome, Dec. 2, 1676. He was educated in the English college at Rome, became a Jesuit, and in 1624 was sent as a missionary priest to England. He returned to Rome in 1627, and from 1637 to 1668 was secretary general of his order. He revised, reedited, and completed the *Bibliotheca Scriptorum Societatis Jesu*, begun by Ribadeneira and continued by Alegambe (fol., Rome, 1676; new ed. by the Jesuit Oudin, Rome, 1745; with supplements, Rome, 1814, 1816). He was also the author of "A Journal of Meditations for Every Day in the Year" (London, 1669).

**SOUTHWELL, Robert,** an English author, born at Horsham St. Faith's, Norfolk, in 1560, executed at Tyburn, Feb. 21, 1595. He was educated at Douai, became a Jesuit at Rome in 1578, was appointed rector of the English college there in 1585, and in 1586 was sent as a missionary to England. He ministered secretly to the scattered Roman Catholics, residing principally as chaplain in the household of the countess of Arundel. In 1592 he was imprisoned in the tower, and was ten times subjected to the torture to make him disclose a plot against Queen Elizabeth. He was much revered among Roman Catholics for his gentleness and purity of life, and his cause has been lately introduced for canonization in the Roman ecclesiastical courts. His most important poems are contained in "St. Peter's Complaint and other Poems" (4to, London, 1595; last ed. with sketch of his life by W. J. Walter, 1817), and "Mæoniæ, or Certaine excellent Poems and Spirituall Hymnes" (4to, 1595). His chief prose works are: "The Triumph over Death" (1595); "Epistle of Comfort to those Catholics who lie under Restraint" (8vo, 1605); and "Marie Magdalen's Funeral Teares" (4to, 1609; new ed., 1823). Collective editions of his works were published in 1620, 1630, 1634, 1637, and 1828; and a complete edition of his poetical works in 1856.

**SOUTHWORTH, Emma D. E.** (Nevitt), an American authoress, born in Washington, D. C., Dec. 26, 1818. She was married in 1841, and two years later, being thrown upon her own resources, she resorted to her pen for support. She wrote for the "National Era," a newspaper published in Washington, and in 1849 republished from it her first novel, "Retribution." Her later works are very numerous, including "The Deserted Wife," "Shannondale," "The Curse of Clifton," "The Lost Heiress," "The Discarded Daughter," "Cruel as the Grave," "Tried for her Life," "A Beautiful Fiend" (1873), and "The Spectre Lover" (1875). An edition of her works was published at Philadelphia in 1872, in 35 vols.

**SOUVESTRE, Émile,** a French author, born in Morlaix, April 15, 1806, died in Paris, July 5, 1854. After failing to get his first drama performed in Paris, he became in 1820 a publisher's clerk at Nantes, and finally a journalist and littérateur, settling in Paris about 1836. After the revolution of 1848 he received a professorship in the new school of administrative science, and delivered popular lectures there and subsequently in Switzerland, which were published under the title of *Causeries historiques et littéraires* (2 vols., 1854). He excelled as a writer of didactic novels and tales. His *Philosophe sous les toits* received in 1851 an academical prize. Shortly after his death the Lambert prize for the most beneficent works was given on his behalf to his widow, who also wrote and translated various works. His sketches of life in Brittany include *Les derniers Bretons* (4 vols., 1835–'7). In 1868 an English translation of his "Legends of Brittany" appeared in New York, and one of "Pleasure of Old Age" in London.

**SOWERBY. I. James,** an English naturalist, born in Lambeth, March 21, 1757, died Oct. 25, 1822. In early life he was a painter of portraits and miniatures, and later took up natural history in connection with his art. He published "English Botany, or colored Figures of all the Plants Natives of Great Britain," with descriptions by Sir J. E. Smith, M. D. (36 vols. royal 8vo, 1792–1807; supplement by his son James De Carle Sowerby, 4 vols., 1815–'49; new ed. by J. T. B. Syme, 10 vols., 1863–'70); "Colored Figures of English Fungi or Mushrooms, with Descriptions" (3 vols. fol., 1797–1809); "British Mineralogy" (5 vols. 8vo, 1804–'17); "Exotic Mineralogy" (2 vols. roy. 8vo, 1811–'17); "British Miscellany" (animal subjects, 12 parts, 1804–'6); and "Mineral Conchology of Great Britain" (6 vols., 600 colored plates, 1812–'41; vols. v. and vi. by his son James De Carle). He was a fellow of the Linnæan and geological societies. **II. George Brettingham,** son of the preceding, born in Lambeth, Aug. 12, 1788, died July 26, 1854. He assisted his father in the entomological portion of his works, and published "Genera of Recent and Fossil Shells" (42 parts 8vo, 264 colored plates, 1822–'34; drawings and engravings by his father and his brother James De Carle), and "Species Conchyliorum, or Original Descriptions and Observations of all the Species of Recent Shells with their Varieties" (4to, 1830, unfinished). **III. George Brettingham,** son of the preceding, born March 25, 1812. He has published "Manual of Conchology," with upward of 650 figures of shells on 24 copper plates (8vo, 1839; 4th ed., revised, 1852); "Conchological Illustrations" (6 vols. 8vo, 1841); "Thesaurus Conchyliorum, or Figures and Descriptions of Shells" (30 parts imp. 8vo, 1842–'71); "Popular British Conchology" (16mo, 1854; new ed., 1866); "Popular History of the Aquarium" (16mo, 1857; new ed., 1865); "Illustrated Companion to Kingsley's Glaucus" (1858); "Illustrated Index of British Shells" (royal 8vo, 24 plates, 1859); and "Labels for the recognized Species of British Shells" (1861). He also furnished drawings for Reeve's "Elements of Conchology" and "Land and Fresh-water Mollusks of the British Isles."

**SOY** (Japanese, *sooja*), a sauce prepared in Japan and China from the seeds of a plant formerly called *soja hispida*, but now *glycine hispida*. The plant is erect, much branched, and roughly hairy, has pea-like flowers in axillary racemes, and hairy pods with two to five compressed seeds. In preparing the soy the seeds are boiled with water nearly to dryness, then put in wide-mouthed jars with water and sugar, and exposed to the sun and air. Every day they are well stirred; and when the fermentation is completed the mixture is strained, salted, and boiled, and skimmed until clarified. Soy

is in general use as a condiment throughout Cochin-China, China, and other eastern countries; the Japanese is considered the best. It has a peculiar flavor, neither too salt nor sweet; a thick consistence and clear brown color; and leaves when shaken in a glass a coat of bright yellowish brown upon the sides. It is imported to be used with fish. The Chinese name for the sauce, according to Archer, is *kitjap*, from which our word catsup or ketchup is derived.

**SOYER, Alexis,** a French cook, born about 1800, died in England, Aug. 5, 1858. For several years anterior to 1850 he was chief cook at the Reform club, London. During the Crimean war he introduced among the troops at Constantinople an intelligent system of cooking. He published "Cookery for the People," *Délassements culinaires* (8vo, London, 1845), "Gastronomic Regenerator" (1847), "The Modern Housewife" (1849), &c.

**SPA,** or **Spaa,** a watering place of Belgium, in the province and 16 m. S. E. of the city of Liége, in a beautiful valley of the Ardennes; pop. about 5,000. It is well built, and has several squares and a fine bathing establishment, erected in 1865. The Pouhon or principal spring is under a colonnade built in honor of Peter the Great, who was here restored to health. The waters are chalybeate, and 150,000 bottles are exported yearly. The annual number of visitors exceeds 16,000.

**SPADA, Lionello,** an Italian painter, born in Bologna in 1576, died in Parma in 1622. He received his earliest education in the school of the Carracci, where he was employed while a boy as a color grinder; subsequently he became a pupil of Caravaggio. After executing important works in Reggio, Modena, and Parma, he entered the service of Ranuccio, duke of Parma. His masterpiece is "San Domenico burning the proscribed Books of the Heretics."

**SPAGNOLETTO,** a Spanish painter, whose real name was José Ribera, born in San Felipe de Jativa, Jan. 12, 1588, died in Naples in 1656. He was a pupil of Caravaggio, whose peculiar style he followed with enthusiasm, and settled in Naples about 1612. He excelled in chiaroscuro, and delighted in gloomy subjects. His chief works are in Spain, but Naples possesses his "Martyrdom of St. Januarius," "St. Jerome and St. Bruno," and "Descent from the Cross." Among his pupils was Salvator Rosa.

**SPAIN** (anc. *Iberia;* Lat. *Hispania;* Span. *España*), a kingdom of S. W. Europe, forming with Portugal the Pyrenean or Iberian peninsula. The name Hispania came into use among the Romans after the destruction of the Carthaginian power in the peninsula. It lies between lat. 36° and 43° 48′ N., and lon. 3° 20′ E. and 9° 21′ W. Its greatest extent N. and S., from Cape Peñas in Asturias to Tarifa point and the strait of Gibraltar, is about 540 m.; E. and W., from Cape Creus in Catalonia to near Cape Finisterre in Galicia, about 630 m. It is bounded N. E. by France, with which it is connected by an isthmus about 240 m. wide, and W. partly by Portugal; on all other sides it is surrounded by water, viz.: E., S. E., and S. by the Mediterranean and the strait of Gibraltar, which separates it from Africa, S. W. and W. by the Atlantic ocean, and N. by the bay of Biscay. In extent it holds the sixth rank among European states, being surpassed by Russia, Sweden and Norway, Austria, Germany, and France.—The coast line of Spain, which forms nearly two thirds of its perimeter, is about 1,370 m. in length, of which about 600 m. belongs to the bay of Biscay and the Atlantic, and 770 m. to the Mediterranean. In the north, from the French frontier to Cape Ortegal and thence to the mouth of the Minho, the coast is rocky, the height ranging from 40 to 300 ft. In the southwest, from the mouth of the Guadiana to that of the Guadalquivir, the shore is mostly low, sandy, and swampy; then it rises gradually, and in the bay of Algesiras presents suddenly the magnificent rock of Gibraltar. From Gibraltar to Cape Palos at the southeast it is mostly rocky, but of little elevation. The E. coast, from Cape Palos to the French frontier, is alternately high and low; a part of it is lined with lagoons, along which numerous salt works are established. The indentations of the Spanish coast are not considerable; the greatest are the bay of Rosas and the gulf of Ampolla in the east, and the gulf of Almería, the strait and bay of Gibraltar, and the bay of Cadiz in the south. Among the most important capes are Creus, St. Sebastian, St. Martin, and Palos in the east, Gata and Trafalgar in the south, Finisterre in the west, and Ortegal, Peñas, and Machichaco in the north. There are few islands near the Spanish coast; the most important are the Balearic, a group consisting of two larger (Majorca and Minorca) and a number of smaller islands, and Iviza and Formentera (the Pityusæ of the ancients). Other small islands are the Isla de Leon, on which Cadiz stands, and the Columbretes, off the coast of Valencia. Excellent harbors are found in the northwest and west, of which those of Ferrol and Vigo are conspicuous; the southwest has the almost unassailable harbor of Cadiz, and the northeast the harbors of Barcelona and Rosas.—Spain has 230 rivers, of which only a few are navigable. From the general direction of the mountain ranges, the main streams flow generally either E. or W. The principal rivers which water the basins inclining toward the Mediterranean are the Ebro, Guadalaviar, Jucar, and Segura, each of which receives several affluents. Five large rivers run into the Atlantic, the Minho (Sp. *Miño*), Douro (*Duero*), Tagus (*Tajo*), Guadiana, and Guadalquivir. Two of these rivers, the Douro and the Tagus, have their mouths in the territory of Portugal, and two others, the Minho and Guadiana, on the confines of the two countries. The most important of them in point of navigation is the Guadalquivir, the others being encumbered with rocks, shallows, and falls. The lakes are

not important; the most remarkable is that of Albufera, S. of Valencia.—Spain is eminently a region of mountain ridges and broad elevated plateaus. From near the Mediterranean to the Atlantic the whole peninsula is traversed by successive mountain belts, including between them high lands watered by numerous small streams. As many as five distinct belts are traced across the peninsula, the most prominent of which, ranging along the northern border, has been described under the heads Cantabrian Mountains and Pyrenees. Each belt is marked by bold precipitous fronts facing the south and gentler slopes toward the north. The second belt, the Sierra de Guadarrama (with its continuations the Sierras de Gredos and de Gata), divides Leon and Old Castile from Estremadura and New Castile, and the waters of the Douro from those of the Tagus. Some of its peaks, as the Puerto del Pico in the province of Ávila, and Peñalara on the border of Segovia and Madrid, rise to a height of about 8,000 ft. Toward the east, on the borders of Aragon, this belt is broken up into various irregular ranges which, under the name of the Iberian chain, including in this designation the spur from the Cantabrians before referred to, extend in a S. E. direction and spread over the E. coast. The third range, called the mountains of Toledo, separate the waters of the Tagus from those of the Guadiana. This range is less marked than the others. The next is the Sierra Morena, along the southern slopes of which flow the branches of the Guadalquivir. Under various names this important belt is traced from the province of La Mancha on the east to the S. W. extremity of Portugal at Cape St. Vincent. The name Morena, brown or dark-colored, is said to be given to the mountains from the dingy color of the forests of kermes oak along the southern edge. The southern coast range, of which the Sierra Nevada forms a part, and which is spoken of collectively by that name, runs close to the Mediterranean, through southern Murcia and Andalusia, from Cape Palos to Cadiz by one branch, and to the rock of Gibraltar by another. It contains the Cerro de Mulhacen, the highest point of the peninsula, and of Europe except in the Alps and the Caucasus, being 11,654 ft. high, and the peak of Veleta, 11,375 ft. Besides these there are numerous minor ranges, which may be regarded as offshoots or continuations of the principal chains. —The geological formations of Spain range with the mountains E. and W. across the peninsula, and consist in the mountains themselves of metamorphic granites and crystalline schists, and on their flanks are represented the Silurian, Devonian, and sometimes the carboniferous formations. In Asturias the last named are met with in highly tilted strata. The older palæozoic rocks are frequently covered by groups of the tertiary, some of the most recent of which, as along the southern slopes of the Guadarrama, lie inclined from the uplifting of the mountains, and in Leon along the Cantabrian range they even stand in a vertical position; but back from the mountains over the great plains of Castile the same strata lie horizontally. The uplifting of the Sierra Morena appears to have been previous to the deposition of the miocene, calcareous beds of which, filled with fresh-water shells, are seen on both sides of the mountains lying horizontally upon highly inclined Silurian slates. The Iberian chain is in great part made up of the newer secondary formations. Moncayo on the western borders of Aragon, the highest mountain of this group, is referred to the Jura, and many other mountains in the eastern provinces more than 5,000 ft. high are composed of Jurassic or cretaceous rocks. These formations extend around on the S. coast, and the rock of Gibraltar is Jurassic limestone. The trias also is traced from the Pyrenees to Andalusia, near the Mediterranean, in beds of conglomerates, sandstones, limestones, clays, marl, gypsum, and salt. —The mineral productions of Spain are various and rich, and its mines of lead, mercury, tin, iron, silver, copper, salt, &c., have been worked from the remotest times. Iron ores are very generally diffused, but the production of iron is comparatively small. Linares, in the province of Jaen, and the Sierra de Gador, a spur of the Nevada, possess rich mines of lead. The little copper produced in Spain is chiefly from the mines of Linares and that of Rio Tinto N. W. of Seville, all in Andalusia. Tin ores are found only in Galicia, and are worked to a very moderate extent. Lead and copper are also found here, and in ancient times silver and gold were produced in Galicia. Antimony was formerly extracted from the mines of La Mancha. Near Cardona in Catalonia are famous mines of rock salt associated with beds of gypsum in the trias formation. Silver is now obtained only from the mines of Guadalcanal, in the province of Seville. The quicksilver mines of Almaden, in Ciudad Real, are the richest in Europe. Asturias and Aragon have important coal mines.—The climate of Spain is divided into three greatly differing zones. The northern zone, which extends to the Ebro and the Minho, comprises Galicia, Asturias, the Basque provinces, Navarre, Catalonia and the northern part of Old Castile, and Aragon. The mountains which cover this zone, the almost perpetual snows of the Pyrenees, together with the N. and N. E. winds, lower the temperature, increase the number and supply of the waters, and promote vegetation. Agriculture is therefore the principal occupation, especially of the Basques and Catalonians. The winters in this zone are generally cold, and the springs moist; but the climate is on the whole temperate. The middle zone, which embraces northern Valencia, New Castile, southern Old Castile, southern Aragon, Leon, and Estremadura, is composed of vast and elevated plateaus, the uniform and monotonous surface of which is swept by the winds

69°
71°
Longitude East 73° from Washington
BAY OF BIS
C. Ortegal
C. Vares
Ferrol
Corunna
C. Villano
Betanzos
Mondoñedo
Villalba
Lugo
Vimanzo
Tambre R.
Santiago
C. Finisterre
Noya B.
GALICIA
Arosa B.
Pontevedra
Pontevedra B.
Redondela
Vigo B.
Vigo
Orense
Sil
Quiroga
Nogales
Villafranca del Vierzo
Puente de Domingo Flores
Leon
Astorga
Allariz
Viana de Bollo
Navia R.
C. Vidio
Nalon R.
C. Peñas
Gijon
Oviedo
ASTURIAS
Cantabrian Mounts
S. Vincente
Santander
Santillana
Potes
Orduña
Villarcayo
VASC
ALAVA
Cervera
Pisuerga R.
Carrion R.
Almansa
Cea
Sahagun
Miranda
Villadiego
Burgos
Logroño
Najera
Valencia de Don Juan
Carrion
Benavente
Villaraniel
OLD
Palencia
CASTILE
42°
R. Minho
Caminha
Monterey
Ponte do Lima
Vianna
R. do Lima
Braga
R. Cavado
Chaves
Braganza
MINHO
TRAS OS MONTES
Guimaraens
Villa Real
OPORTO
Penafiel
Villanova de Gaya
S. Pedro
Medina de Rio Seco
LEON
Peñaflor
Zamora
Simancas
Toro
Valladolid
Aranda
Osma
Douro
Cuellar
Bocequillas
Fermoselle
Medina del Campo
Ledesma
R. Tormes
Salamanca
Vitigudino
Navalmanzano
Guadarrama
Somosierra
Tamajon
Segovia
Henares
P. de Peñalara
Guadalajara
Lamego
Feira
Ovar
Vizeu
Lamegal
Aveiro
Guarda
Almeida
BEIRA
Ciudad Rodrigo
Alba de Tormes
Avila
Fuentes de Oñoro
Coimbra
R. Mondego
Sortelha
El Barco
Guisando
el Escorial
MADRID
Alcalá de Henares
Sa. Estrella
Gata
Bejar
Sa. de Gredos
Escalona
NEW
Arganda del Rey
Cilleros
Alagon
SPAIN
40°
Pombal
R. Zezere
Castello Branco
Plasencia
Retamar
Toledo
Aranjuez
Ocaña
Parred
Leiria
R. Tagus
Talavera de la Reina
Almaraz
Puente del Arzobispo
Torres Novas
Abrantes
Alcantara
Membrio
Cáceres
Jaraicejo
Trujillo
Sierra de Toledo
CASTILE
Peniche
Roliça
Vimieira
Santarem
Castello Vide
La Cumbre
Guadalupe
ESTREMADURA
Torres Vedras
Pombas
Portalegre
Miajadas
Herrera del Duque
Zarzuela
Villar del Rey
Medellin
Carrion
Cintra
LISBON
R. Tagus
Sa. de Ossa
Estremoz
Elvas
Merida
Villanueva de la Serena
Guadiana
Ciudad Real
Setubal
Badajoz
Guareña
Almaden
Almodovar del Campo
Almagro
C. Espichel
Evora
Redondo
Albuera
Zujar
Santa Eufemia
LA MANCHA
Puertollano
Olivenza
Villafranca de los Barros
Los Pedroches
Oriola
Cuba
Zafra
Mourão
Beja
Fuente de Cantos
Llerena
La Granja
Torre Hermosa
Villaharta
Sierra Morena
Baylen
Linares
Baeza
38°
C. Sines
Santiago de Cacem
Fontao
ALEMTEJO
Moura
Cambres
Campo Frio
Montoro
Andujar
PORTUGAL
Cercal
Ourique
Alajar
Cordova
Guadalquiver
Bujalance
Jodar
Santa Olaya
Posadas
Odemira
Almodovar
El Cerro
Cazalla
Castro del Rio
Martos
Jaen
Montilla
Alcala Real
Cambil
Sa. Monchique
Valverde
Ecija
ANDALUSIA
Bacor
Lagos
ALGARVE
Sn. Lucar de Barrameda
Ayamonte
Sn. Lucar La Mayor
SEVILLE
Lucena
GRANADA
Guadix
C. St. Vincent
Sagres
Tavira
Huelva
Palos
Utrera
Osuna
Estepa
R. Genil
Loja
P. de Veleta
Faro
Cabezas de S. Juan
Antequera
Alhama
Sierra Nevada
C. S. Maria
R. Guadalquiver
Lebrija
S. Lucar
Arcos de la Frontera
Xeres
Alora
Colmenar
Malaga
Ronda
Velez Malaga
Motril
Cadiz
Po. S. Maria
S. Fernando
Marbella
Medina Sidonia
Barrosa
Estepona
36°
C. Trafalgar
Algeciras
Tarifa
Gibraltar
Strait of Gibraltar
C. Spartel
Tangier
Ceuta
AFRICA
8°
4°
ATLANTIC OCEAN


SPAIN
AND
PORTUGAL
English Miles
10 20 40 60 80 100
Names of provinces in Spain are underlined thus. NAVARRE
The towns underlined thus. GRANADA give names to the provinces.
West 2° from Greenwich
0° Longitude East 2°
75°
77°
79°
81°
42°
40°
38°
36°
F R A N C E
PYRENEES MOUNTAINS
MEDITERRANEAN SEA
BALEARIC ISLANDS
Bayonne
R. Nive
Irun
Tolosa
Roncesvalles
Pamplona
NAVARRE
Sangüesa
R. Arga
R. Aragon
Tudela
Tarazona
Agreda
Uncastillo
Ejea de los Caballeros
Jaca
Ayerbe
Huesca
R. Gallego
Zuera
Saragossa
R. Cinca
Ainsa
Barbastro
Monzon
MPerdu
Mt. Maladetta or P. Nethou
Montcalm
Sas
Tremp
Benavarre
Andorra
Bellver
Ripoll
Gavarra
Solsona
Balaguer
Lérida
R. Segre
Cervera
CATALONIA
Manresa
Monserrat
Vich
R. Ter
Gerona
Figueras
Rosas
C Cervera
C. Creux
G. of Rosas
C. Bagur
S. Feliu de Guixols
Mataró
BARCELONA
Llobregat
Igualada
Cabellas
Reus
Tarragona
Mequinenza
Bujaraloz
R. Ebro
Mediana
Jalon
Calatayud
Cariñena
R.
Medinaceli
ARAGON
Tortuera
Daroca
Muniesa
Caspe
Alcañiz
Tirisa
Pinell
Tortosa
Calanda
Molina de Aragon
Monroyo
R. Ebro
Buda I.
Pt Bana
Carrascosa del Tejo
Monreal del Campo
Cella
Aliaga
Morella
Sa Albarracin
Teruel
Linares
Vinaroz
Benicarló
Cabanes
Oropesa
Ademuz
Cuenca
R. Mijares
Castellon de la Plana
Villareal
Columbretes Rocks
Pajaron
Cardenete
Segorbe
R. Guadalaviar
Liria
Murviedro
VALENCIA
Motilla
Caudete
R. Cabriel
Requena
R. Jucar
Iniesta
Buñol
Barco del Jucar
L. de Albufera
Alcira
R. Jucar
Albacete
Ayora
Játiva
Chinchilla
Almansa
Gandia
Denia
Onteniente
Alcoy
C. S. Martin
Hontur
MURCIA
Jijona
Segura
Jumilla
Elche
Alicante
Caravaca
Orihuela
Murcia
R. Segura
Pliego
R. Sangonera
Mar Menor
Lorca
Cartagena
C. Palos
Velez Rubio
R.
Vera
Mojacar
C. Gata
G. of Almeria
MINORCA
Mahon
Soller
Palma
MAJORCA
Cabrera I.
IVIZA
Iviza
PITHYUSA ISLES
Formentera


SPAIN
AND
PORTUGAL
English Miles
Names of provinces in Spain are underlined thus. NAVARRE
The towns underlined thus. GRANADA give names to the provinces.
Longitude East 73° from Washington
Longitude West 2° from Greenwich
Longitude East
BAY OF BISCAY
FRANCE
PYRENEES MOUNTAINS
ATLANTIC OCEAN
MEDITERRANEAN SEA
BALEARIC ISLANDS
MINORCA
MAJORCA
IVIZA
PITHYUSA ISLES
Formentera
Cabrera I.
Mahon
Palma
Columbretes Rocks
Strait of Gibraltar
AFRICA
Tangier
Ceuta
C. Spartel
Gibraltar
GALICIA
ASTURIAS
LEON
OLD CASTILE
NEW CASTILE
NAVARRE
ARAGON
CATALONIA
VASCONGADAS
ESTREMADURA
LA MANCHA
MURCIA
ANDALUSIA
VALENCIA
MINHO
TRAS OS MONTES
BEIRA
ESTREMADURA
ALEMTEJO
ALGARVE
PORTUGAL
SPAIN
MADRID
LISBON
OPORTO
BARCELONA
SEVILLE
GRANADA
Coruña
Santander
Oviedo
Bilbao
Pamplona
Saragossa
Valladolid
Salamanca
Toledo
Badajoz
Cordova
Malaga
Cadiz
Cartagena
Alicante
Valencia
Tarragona
Lerida
Huesca
Burgos
Leon
Lugo
Santiago
Pontevedra
Orense
Zamora
Segovia
Avila
Guadalajara
Cuenca
Teruel
Soria
Logroño
Vitoria
Palencia
Caceres
Ciudad Real
Albacete
Murcia
Jaen
Almeria
Huelva
Coimbra
Braga
Evora
Faro
Tavira
Sagres
C. S. Vincent
C. Finisterre
C. Ortegal
C. Creux
C. Palos
C. S. Martin
C. Trafalgar
C. Gata
Sierra Nevada
Sierra Morena
Sierra de Guadarrama
Cantabrian Mounts
R. Ebro
R. Tagus
R. Douro
R. Guadiana
R. Guadalquivir
R. Jucar
R. Segura
R. Minho

and burned by the sun. Although high mountain ridges line and traverse this region, it has few rivers, not sufficient to fertilize it. The temperature is subject to extremes; the winters are cold and the summers burning, but the spring and autumn are pleasant. The southern zone, which comprises Andalusia, Murcia, and southern Valencia, is exposed to the influence of the burning winds from Africa, and to the reflection of the rays of the sun from the naked and rocky mountain walls. The valleys in this zone are deeper and the plateaus less extended and better supplied with water than in the middle zone; the soil is more diversified and better adapted for agriculture. The temperature, delicious in autumn and in spring, is tropical in summer, and more rainy than cold in winter. Two kinds of winds are very troublesome. The *gallego*, a N. and N. W. wind, blowing from Galicia, is cold and piercing, and causes painful affections of the eye. The southern provinces are visited by the *solano*, the sirocco of Italy.—Spain is one of the most fruitful countries of Europe. Wheat, maize, barley, hemp, and flax are extensively cultivated, especially in the eastern and northern provinces. Saffron and other dye plants are chiefly found in the interior. Mulberry trees are largely cultivated for rearing silkworms in Valencia, Murcia, and Granada. In the south there is a great variety of the finer fruits, including the almond, date, fig, orange, citron, pomegranate, pineapple, and banana. Large forests, especially of evergreen oaks, including the cork tree, are still found in Asturias, the Pyrenees, the Sierra Morena, and the Sierra Nevada; but on the whole Spain has less timber than any other of the large countries of Europe, owing to the want of cultivation. The culture of the vine is general; but only the coast districts of Jerez, Rota, and Malaga, in Andalusia, and of Benicarlo and Alicante in Valencia, furnish considerable quantities for exportation. The quadrupeds, birds, reptiles, and insects are mostly of the same kinds as those of S. France. Wolves, lynxes, foxes, and wild boars are still to be found on the high mountains; but the bear, which two centuries ago was common, is only to be met with in the Pyrenees. The Barbary ape, the only monkey naturalized in Europe, inhabits the rock of Gibraltar. Descended from breeds which the Moors introduced, the Spanish horse has preserved the fire, docility, grace, and vigor of the Arabian. Those of Seville, Granada, and Estremadura are most valued. The asses and mules are superior; the former rival those of Egypt, but mules are preferred for transportation. The bulls used for bull fights are found wild in the Sierra Morena. Sheep are everywhere extensively raised, a considerable proportion belonging to the merino breed. Hogs are bred in large numbers; those of Estremadura, Galicia, and Asturias are celebrated for the delicacy of their flesh. There are important fisheries on the coasts; the fish of the Atlantic are preferred to those of the Mediterranean.—The kingdom, inclusive of the less remote islands, is divided into 49 provinces, named after their respective capitals except the last six in the table, viz.: Navarre, capital Pamplona; Biscay, Bilbao; Guipúzcoa, St. Sebastian; Álava, Vitoria; Balearic Islands, Palma; Canary Islands, Santa Cruz de Tenerife. The area and population of the provinces and of the ancient divisions, according to official estimates in 1870, are given in the *Almanach de Gotha* for 1875 as follows:

| PROVINCES. | Area, sq. m. | Population. |
|---|---|---|
| NEW CASTILE. | | |
| 1. Madrid | 2,997 | 487,482 |
| 2. Toledo | 5.586 | 342,272 |
| 3. Guadalajara | 4.869 | 208,638 |
| 4. Cuenca | 6,726 | 238,731 |
| Total | 20,178 | 1,277,123 |
| LA MANCHA. | | |
| 5. Ciudad Real | 7,840 | 264,649 |
| OLD CASTILE. | | |
| 6. Burgos | 5,651 | 353.560 |
| 7. Logroño | 1.945 | 182.941 |
| 8. Santander | 2,113 | 241.581 |
| 9. Soria | 3,836 | 158,699 |
| 10. Segovia | 2.714 | 150.812 |
| 11. Ávila | 2.982 | 175.219 |
| 12. Palencia | 3,126 | 184.668 |
| 13. Valladolid | 3,043 | 242,384 |
| Total | 25,409 | 1,689,864 |
| LEON. | | |
| 14. Leon | 6.167 | 350.092 |
| 15. Zamora | 4,135 | 250.968 |
| 16. Salamanca | 4.940 | 280.870 |
| Total | 15,242 | 881,930 |
| ASTURIAS. | | |
| 17. Oviedo | 4,091 | 610,553 |
| GALICIA. | | |
| 18. Corunna | 3.079 | 630.504 |
| 19. Lugo | 3,787 | 475.836 |
| 20. Orense | 2,739 | 402.796 |
| 21. Pontevedra | 1,739 | 480,145 |
| Total | 11,344 | 1,989,281 |
| ESTREMADURA. | | |
| 22. Badajoz | 8,688 | 431.922 |
| 23. Cáceres | 8,014 | 302,455 |
| Total | 16,702 | 734.377 |
| ANDALUSIA. | | |
| 24. Seville | 5.295 | 515.011 |
| 25. Cadiz | 2.809 | 426.499 |
| 26. Huelva | 4.122 | 196.469 |
| 27. Cordova | 5.190 | 382.652 |
| 28. Jaen | 5.184 | 392.100 |
| 29. Granada | 4.937 | 485.346 |
| 30. Almeria | 3.302 | 361.553 |
| 31. Malaga | 2.824 | 505.010 |
| Total | 33,663 | 3,264,640 |
| MURCIA. | | |
| 32. Murcia | 4.478 | 439.067 |
| 33. Albacete | 5.972 | 220.973 |
| Total | 10.450 | 660.040 |
| VALENCIA. | | |
| 34. Valencia | 4.352 | 665.141 |
| 35. Alicante | 2.098 | 440.470 |
| 36. Castellon | 2.447 | 296,222 |
| Total | 8,897 | 1,401,833 |

| PROVINCES. | Area, sq. m. | Population. |
|---|---|---|
| CATALONIA. | | |
| 37. Barcelona | 2,985 | 762,555 |
| 38. Tarragona | 2,451 | 350,395 |
| 39. Lérida | 4,775 | 330,348 |
| 40. Gerona | 2,272 | 325,110 |
| Total | 12,483 | 1,768,408 |
| ARAGON. | | |
| 41. Saragossa | 6,607 | 401,894 |
| 42. Huesca | 5,878 | 274,623 |
| 43. Teruel | 5,494 | 252,201 |
| Total | 17,979 | 928,718 |
| NAVARRE. | | |
| 44. Navarre | 4,046 | 318,687 |
| BASQUE PROVINCES. | | |
| 45. Biscay | 849 | 187,926 |
| 46. Guipúzcoa | 728 | 180,743 |
| 47. Álava | 1,205 | 103,320 |
| Total | 2,782 | 471,989 |
| 48. Balearic Islands | 1,860 | 289,225 |
| 49. Canary Islands | 2,808 | 283,859 |
| Total of Spain in Europe and Canaries | 195,774 | 16,835,506 |

The area and population of the foreign colonies of Spain according to the latest data are as follows:

| COLONIES. | Area, sq. m. | Population. |
|---|---|---|
| AMERICA. | | |
| Cuba | 45,883 | 1,400,000 |
| Porto Rico | 3,596 | 625,000 |
| Total | 49,479 | 2,025,000 |
| ASIA AND OCEANICA. | | |
| Philippines (exclusive of independent parts) | 65,908 | 6,000,000 |
| Carolines and Palaos | 916 | 28,000 |
| Ladrones or Marianas | 417 | 5,610 |
| Total | 67,241 | 6,033,610 |
| AFRICA. | | |
| The Guinea islands | 489 | 35,000 |
| Total Spanish colonies | 117,209 | 8,093,610 |

The Canary islands, which geographically belong to Africa, are included by the Spaniards in their European possessions. Besides them, the town of Ceuta, on the coast of Morocco, is included in the European province of Cadiz, and the Presidios, likewise on the N. coast of Africa, are included in the European province of Granada. In population Spain ranks seventh among the powers of Europe, being surpassed by Russia, Germany, France, Austria, Great Britain, and Italy. The increase since 1700 is shown in the following table:

| YEARS. | Population. | YEARS. | Population. |
|---|---|---|---|
| 1700 | 8,000,000 | 1849 | 14,216,219 |
| 1769 | 9,160,000 | 1857 | 15,454,514 |
| 1797 | 10,541,000 | 1870 | 16,835,506 |
| 1834 | 12,597,719 | | |

The increase since 1834 has been about equally divided; only one province, Ciudad Real, shows a small decrease, from 277,788 to 264,649. The largest ratio of increase is in the eastern provinces, where Lérida has advanced from 151,322 to 330,348, Valencia from 388,759 to 665,141, and Barcelona from 442,273 to 762,555. The thinnest population is found in the interior provinces of Leon, the two Castiles, and Estremadura; and the densest in the north, Galicia, Asturias, the Basque provinces, Navarre, Aragon, and Catalonia. The entire population is distributed among 169 *ciudades* (cities), 4,707 *villas* (towns), 30,386 *lugares* (villages), and 10,788 *aldeas* (hamlets). The principal cities are Madrid, the capital, Barcelona, Malaga, Valencia, Seville, Granada, Cadiz, and Saragossa. Spain is believed to have been in former times much more densely inhabited than during the last two centuries. Under the dominion of the Romans, the population, according to some calculations, was upward of 30,000,000; and in the 14th century it is believed to have amounted to 24,000,000. Most of the inhabitants belong to the Spanish race, a mixture of the descendants of the old Iberians and Celts with the Carthaginians, Romans, Vandals, Suevi, Goths, and Moors, with a general predominance of the Roman element, although the several provinces show in some respects marked differences in the national character. National amusements are music, singing, and dancing, the last named often assuming, especially in the favorite *fandango* and *bolero*, a passionate and sensuous character. From the Romans the Spaniards have inherited a fondness for bull fights, which are still the greatest popular festivities, and equally delight all classes. The men are generally well built, and have a dark but clear complexion, black hair, eyes full of fire, sharp features, and gestures measured and solemn. The women are well formed and distinguished for noble carriage. Besides the Spaniards proper, there are three other races, the Basques, the Modejars, and the gypsies. The Basques, probably the descendants of the ancient Iberians, numbering (besides those in France) about 650,000, and forming the majority of the population in the Basque provinces and in Navarre, have retained their ancient language, manners, and customs. (See BASQUES.) The Modejars, about 60,000 in number, are the descendants of the Moors; they are chiefly found in Granada and Castile, and many of them still preserve the customs of their forefathers. The gypsies or Gitanos, numbering about 50,000, and scattered throughout Spain, speak a peculiar dialect current only among themselves. Spain has a very numerous nobility; according to some they form the 21st, according to others even the 15th part of the population. The higher nobility (*titulados*, *grandes*) own immense possessions, while the lower class (*hidalgos*) are in many instances poor.—Agriculture, although still very imperfect, has made of late considerable progress. Wheat, which at the beginning of the century

was not yet grown in sufficient quantities for home consumption, forms now a considerable article of export. Wine and oil constitute the chief riches of some of the provinces. Agriculture has made especial progress in Biscay, Navarre, and Aragon, and all the arable ground near the roads has been cultivated. But the most careful cultivation is found in the *huertas* or irrigated lands of Granada, Murcia, and Valencia, which are regarded as the gardens of Spain, and produce all kinds of fruits, vegetables, and plants. The farmers are for the most part wretchedly poor, and are obliged to obtain money at exorbitant prices by mortgaging their crops. Certain privileges, very injurious to the interests of agriculture, are enjoyed by the proprietors (called *mestas*) of large migratory flocks of sheep, especially merinos. They are not only allowed to drive their flocks over village pastures and commons, but the proprietors of such cultivated lands as lie in their way are obliged to leave for them a wide path; and no new enclosures can be made in the line of their migrations, nor can any land that has once been in pasture be again cultivated till it has been offered to the *mesta* at a certain rate. Only about 53 per cent. of the soil is under cultivation.—Manufacturing industry in former centuries was very prosperous. In the middle ages, the wool and silk tissues of Seville, Granada, and Baeza, the cloths of Murcia, and the arms of Toledo enjoyed a high reputation. The expulsion of the Moors and Jews, the monopoly given to the royal manufactories, the onerous taxes weighing down private industry and aggravated by the avidity of the fiscal agents, combined to undermine this prosperity. Seville in 1519 counted 16,000 silk workshops, employing 130,000 workmen; in 1673 it had only 405 manufactories. The manufactories of Segovia, in which formerly 25,000 pieces were annually produced, made in 1788 only 400 pieces. In recent times industry has greatly improved again, especially by the influx of foreign capital, as a considerable portion of the former property of the clergy has passed into the hands of French and English capitalists. The cotton industry, which is concentrated chiefly in Barcelona and other places in Catalonia, employs 1,200,000 spindles, and supports about 100,000 men. Metallurgic industry has been developed in Guipúzcoa, Biscay, Aragon, Catalonia, and Granada; silk goods are manufactured at Barcelona, Manresa, Tarragona, Toledo, Seville, and Valencia; woollen stuffs at Segovia, Arevalo, Colmenar (on the Manzanares), and Alcoy; linen in Galicia and Catalonia; leather at Barcelona, Cordova, Burgos, Toledo, Granada, and Madrid; and glassware at Barcelona. There are manufactories of firearms in the Basque provinces, Catalonia, and Segovia, and cannon founderies at Seville, Liergames, Trubia, and Barcelona. The number of stock companies has greatly increased of late years. At the close of 1866 there were 65 credit and other commercial and industrial associations, with a nominal capital of $37,900,000. In 1867 there were 27 railroad and other public works associations, with a nominal capital of $204,480,000. The number of banks was 23, capital $35,600,000. A decree of March 19, 1874, founded a new national bank, with which the old privileged Spanish bank and the provincial banks were to be consolidated.—The first railroad in Spain was opened in 1848, from Barcelona to Mataro, 18½ m. Notwithstanding the mountainous nature of the country, their extension has been pursued with some vigor; but in consequence of the wretched state of Spanish industry, the want of good inland roads, and frequent political disturbances, the financial condition of the railroads is unsatisfactory, and their progress has been less rapid lately than in any other European country. In 1867 only 26 m. of new railroads were opened; in 1868, 72 m.; in 1869, 6 m.; in 1870, 36 m.; in 1871, 20 m.; in 1872 and 1873, 60 m. Some of the main lines were not yet completed in 1875. The aggregate length of the railroads on Jan. 1, 1874, was 3,364 m. In 1867 the number of passengers carried was 10,357,351. The total length of telegraph lines in 1871 was 7,287 m.; number of stations, 193; number of despatches, 996,912. The number of post offices was 2,347; of letters, 78,174,000. There are several canals, some of them on a magnificent scale, but mostly unfinished and unfit for navigation. The chief of these are the Imperial canal, begun by Charles V., and extending along the right bank of the Ebro, and the canals of Castile, Manzanares, Murcia, Albacete, and Guadarrama. The aggregate length of the canals in 1874 was 430 m., of which 131 m. were navigable. The number of the boats on the latter was 332.—The most important articles of export are wines, specie, metals, especially lead, raisins, olive oil, flour, cork, soap, wool, brandies, and salt; and the imports comprise sugar, cotton and cotton goods, woollen, silk, and linen goods, iron in bars, codfish, machines, cacao, guano, and coal. In 1849 a protective tariff was adopted in place of the former prohibitive system. A decree of the regency, dated Aug. 1, 1869, introduced a new tariff, which abolished all prohibitions and reduced considerably the duties on most articles. It provided also for a further reduction to take place on July 1, 1875. The imports and exports from 1867 to 1869 inclusive, according to official reports, were as follows:

| YEARS. | Imports. | Exports. |
|---|---|---|
| 1867 | $76,800,000 | $56,600,000 |
| 1868 | 110,200,000 | 53,300,000 |
| 1869 | 84,900,000 | 51,200,000 |

The trade of Spain is chiefly with France, Great Britain, and Cuba. In 1867 the value of im-

ports from France was $33,648,000, from Great Britain $26,112,000, and from Cuba $7,680,000; of exports to France $15,936,000, to Great Britain $16,224,000, and to Cuba $9,936,000. The merchant navy in 1867 consisted of 4,363 sailing vessels, tonnage 345,186, and 151 steamers, tonnage 45,484; total, 4,514 vessels, of 390,670 aggregate tonnage. In the same year 9,640 vessels, of 1,532,000 aggregate tonnage, entered the ports.—The government of Spain, which has undergone many changes since 1812, is now a constitutional monarchy. The constitution of June 1, 1869, vests the legislative power in a cortes, as representative of the sovereign Spanish nation. The king, who is inviolable and not subject to responsibility, sanctions and promulgates the laws, and exercises the executive power through the state ministry. In January, 1875, the ministry was composed of a president and eight ministers, the departments being foreign affairs, finance, interior, justice, commerce and public works, war, marine, and colonies. The cortes is divided into a senate and the congress. The requirements for a senator are to be a Spaniard, to be 40 years of age, to be possessed of civil rights, and either to have been the occupant of a high political, ecclesiastical, or literary position, or to be one of the large taxpayers. One fourth of the senate is removed each time that general elections for deputies are held. The lower house, the congress, which is wholly renewed every three years, is composed of at least one deputy to each 40,000 of the population. To be eligible as a deputy one must be a Spaniard, of age, and in possession of civil rights. The cortes must meet for at least four months every year. Each house nominates its own officers. The provinces, districts, and communes of Spain are governed by their own special laws, and this principle of provincial and municipal self-government has generally been recognized by all the governments. Every commune of at least 60 members has its own elected *ayuntamiento*, which is presided over by an alcalde. Each province has its own parliament, the *deputacion provincial*, the members of which are elected by the ayuntamientos. The courts of justice comprise the supreme tribunal at Madrid, 15 *audiencias territoriales* (courts of the second resort), and 499 courts of ordinary jurisdiction. The army of Spain, according to the military law of Feb. 17, 1873, is divided into the active army and the reserve. The former, the numerical strength of which is established annually by a law, is recruited wholly by volunteers from 19 to 40 years of age, who enlist for a term of at least two years, after the expiration of which they may reënlist for at least one year. The reserve is formed of all who have reached their 20th year, excepting those who serve in the active army. The time of service is three years, and no substitutes are accepted. The reserve of a province may be mobilized by a decree of the government, but the mobilization of the entire reserve requires a national law. Whenever the number of volunteers is insufficient to fill the active army, the reserve may be mobilized. In 1875 the Spanish army was in process of reorganization on the basis of these provisions. The military force in Spain was to number about 216,000 men. To this number should be added about 60,000 men in Cuba, 9,400 in Porto Rico, and 9,000 in the Philippines; total, 78,400, making the whole strength of the Spanish army 294,400. As it has been common with most of the governments which have followed each other in rapid succession to make military appointments for political reasons, the number of officers of the highest military rank is disproportionately large. There is a school of infantry cadets at Toledo, a school of cavalry cadets (established in 1851) at Alcalá de Henares, a special school of artillerists, an academy of engineers, and a school of the general staff at Madrid, and a general military school at Toledo. Spain has 125 fortified places, among which are 25 of the first order. The navy, which in former times commanded all seas, and afterward greatly declined, has only recently begun to improve again. The fleet in 1874 consisted of 20 vessels of the first class (7 ironclads, 10 screw frigates, and 3 wheel steamers), 21 vessels of the second class (10 wheel steamers, 9 screw steamers, and 2 screw transports), and 161 vessels of the third class (20 screw steamers, 54 gunboats, 10 wheel steamers, 4 screw transports, and 73 brigs); total, 202 vessels with 894 guns. Besides these are the following vessels not classified: 5 steamers with 5 guns, a monitor with 3 guns, 2 despatch boats with 6 guns, 1 floating battery, and 1 sailing transport. The navy was manned in 1874 by 9,700 sailors and 5,000 marines.—The finances of Spain have long been in a wretched condition, and there is no longer any hope among Spanish statesmen for a permanent improvement. The apparent surplus of receipts which appeared in several of the budgets presented to the cortes was generally found to be fictitious, and since 1867 even the budget estimates have invariably left a large deficit unprovided for. Even the extensive sale of national and church property has failed to restore the equilibrium and to arrest the threatening increase of the national debt. In the budget for 1871–'2 the revenue was estimated at about $113,500,000, and the expenditures at $121,000,000; and the minister of finance declared that the state was on the verge of bankruptcy, which could be averted only "by the most strenuous exertions, devoted both to raise the revenue by the imposition of new taxes and otherwise, and to depress the expenditure to the lowest possible point." A report of the minister of finance in May, 1873, estimated the public debt at $1,511,000,000. The payment of interest on the foreign debt was suspended on July 1, 1873. According to the Madrid "Official Ga-

zette" the total revenue for 1874–'5 was $108,-960,000, and the total expenditure $104,105,-000. The revenue was derived chiefly from direct and indirect taxes, stamps, tobacco and other monopolies, sales of national property, and exemptions from military service. The receipts from colonies amounted to only $595,-000. The chief items of expenditure were $55,800,000 for war and marine, and $31,-195,000 for the other ministries. This statement shows a slight surplus of revenue, but if the interest on the public debt had been paid there would have been the usual deficit. —Of the coins of Spain, the *real* is equal in value to about 5 cts., the *peseta* is equal to four *reales*, and the *escudo* to ten *reales*. The French metric system was introduced Jan. 1, 1859, but the old weights and measures are still much used.—Nearly the whole population of Spain belongs to the Roman Catholic church; and before the establishment of the Spanish republic in 1868 no other religious denomination was recognized by law or enjoyed the right of public worship. To teach or to embrace Protestantism, or to circulate, buy, or sell Protestant books, was also punishable by law. Only a few congregations of foreign Protestants and Jews were allowed to worship according to the rites of their respective religions. A few natives were known to profess Protestant opinions, and they gradually came to be tolerated as long as they did not assemble for public worship. After the expulsion of Queen Isabella Protestant congregations were formed in all the large and in some of the small towns; they were soon organized into a Spanish evangelical synod, and a consistory was appointed in Madrid for administrative purposes. Besides the congregations connected with this synod, there are a few Baptist, Scotch Presbyterian, and Anglican churches. The whole number of Protestants in 1874 was variously estimated from 30,000 to 120,000. The Roman Catholic church in Spain is divided into 54 dioceses, 9 of which are archbishoprics, viz.: Burgos, Santiago, Granada, Saragossa, Toledo, Tarragona, Seville, Valencia, and Valladolid. In the Spanish possessions out of Europe, there are in America one archbishopric (Santiago de Cuba) and two bishoprics; in Asia, one archbishopric (Manila) and four bishoprics. The archbishop of Toledo is primate of Spain. In 1830 the clergy and religious orders counted 152,305 members, including 30,900 monks and 24,700 nuns in 1,940 convents. In 1835–'6 nearly all the convents were suppressed; but subsequently various female communities, mostly devoted to teaching and to the care of the sick, and a few male orders, were reëstablished by permission of the government. In 1860 there were 32 male convents with 719 monks, and 866 female convents with 12,990 nuns. The number of priests in 1867 was 43,948. In former times the church owned immense possessions, but in 1835 they were declared national property and confiscated, and the clergy indemnified by fixed salaries. Up to 1839 the ecclesiastical property which had been sold amounted to $78,000,000. A concordat, concluded Aug. 25, 1859, and promulgated Jan. 14, 1860, stipulated that the church should remain in the possession of all the property not yet disposed of, and should have in future the right of acquiring property of any kind.—The organization of public instruction dates from 1845. At the head of educational affairs is a royal council subdivided into six sections, viz.: primary instruction, philosophy, ecclesiastical sciences, jurisprudence, medical science, and administration of public instruction. In 1852 there were fewer than 2,000,000 individuals who were able to read, and scarcely 1,200,000 knew how to write. Since then the government has made efforts to improve public instruction, and the higher institutions of learning have been the object of special solicitude. In 1867 there were 26,332 public schools, with 1,425,339 pupils, of whom 850,762 were boys and 574,577 girls. In 1872 the middle schools consisted of 50 provincial and 13 municipal institutes, besides several private *colegios*, with an aggregate attendance of about 26,000. Spain has 10 universities, in Madrid, Barcelona, Granada, Oviedo, Salamanca, Seville, Santiago, Valencia, Valladolid, and Saragossa. The total number of students in 1868 was 12,269. Three universities (Madrid, Barcelona, and Granada) have each five faculties (philosophy and literature, exact sciences, pharmacy, medicine, and law), two four faculties, one three faculties, and the others but two. The theological faculties have been abolished in all the universities, and theological instruction is imparted at the seminaries connected with the episcopal sees. Normal schools have been established, in accordance with the law of 1857, in the capitals of the several provinces. Special instruction is provided for by a school of engineering, commercial schools, a college for the deaf and dumb, a school for the blind, and a higher veterinary school at Madrid, with branch establishments at Cordova and Saragossa. Spain has many literary societies, yet none of them can compare with similar societies in most other European countries. The best known among them are the royal academy at Madrid, founded in 1714; the academy of sciences at Seville; the academy of plastic arts at Madrid; the academies of arts at Seville, Cadiz, Valencia, Saragossa, and Palma; the royal academy of Spanish history at Madrid; and the academy of geography at Valladolid. Of public libraries there are the royal library and six others at Madrid, one in the Escurial, two at Valencia, two at Saragossa, and one at Toledo, besides those belonging to the different universities. In 1808 only four periodicals were published in Spain; in 1868 there were 468. In 1867 there were 335 theatres, with accommodations for 169,376 people.—The Spanish peninsula was early visited by the Phœnicians, who established flour-

ishing colonies on its coasts, such as Tartessus (probably the Tarshish of Scripture) and Gades (Cadiz). They were followed by the Greeks, among whose colonies were Emporiæ (now Ampurias, on the coast of Catalonia) and Saguntum (Murviedro, in Valencia). Still the interior remained very imperfectly known, and it was not till the second Punic war that the Romans acquired an accurate knowledge of the country. The Greeks at first applied the name Iberia (corresponding to that of the river Iberus, now Ebro) to the eastern coast, calling the western part of the peninsula Tartessis and the centre Celtica; but later they extended the term Iberia to the whole. The Romans exchanged this name for that of Hispania (whence the modern Spain), supposed by many critics to be derived from the Semitic *shaphan*, rabbit, an animal which the Phœnicians found in vast numbers in the country, and by others to be from the Basque *ezpaña*, border. From remote antiquity the elevated regions of the interior were peopled by the Celtiberians, a race formed from the mixture of Celts and Iberians. (See CELTIBERIANS.) A number of Iberian and Celtic tribes, however, retained their distinct nationality. Among the former were the Astures, Cantabri, and Vaccæi, inhabiting the mountainous districts of the north. The unmixed Celts dwelt chiefly near the Guadiana, and in Gallæcia (Galicia). The Turdetani, who lived in the valley of the Guadalquivir, were accounted the most civilized of the Spanish tribes, and even had a literature of their own. The inhabitants were brave and warlike. Even in antiquity the sheep of Spain were highly prized, and the country produced corn, oil, and wine; but its principal riches lay in its mines of gold, silver, and other metals. After the first Punic war the Carthaginians began to establish themselves in Spain, and, under the leadership of Hamilcar and Hasdrubal, subdued several tribes on the S. and E. coasts. Among the cities founded by them was New Carthage (now Cartagena), which soon became a celebrated emporium. Pressed by the Carthaginians, the Greek colonies of Saguntum and Emporiæ applied for aid to the Romans, who obtained from Carthage an agreement not to extend her dominion beyond the Iberus, and to respect the independence of Saguntum. The siege and destruction of Saguntum by Hannibal in 219 B. C. led to the second Punic war, in the course of which Scipio expelled the Carthaginians from Spain (206). The Romans now undertook the subjugation of the entire peninsula, but did not fully succeed until after a war of about 200 years, in which the exploits of the Lusitanian Viriathus, the heroic resistance and final downfall of Numantia (133), and the temporary independence of a part of the country under the gallant Sertorius (84 to 72) form brilliant episodes. In 19 B. C. the subjection of all Spain, with the exception of the Basques, was completed. Augustus divided the peninsula into three provinces: Hispania Tarraconensis, so named from the capital Tarraco (Tarragona), in the north, east, and centre; Hispania Bætica (from the Bætis, now Guadalquivir), in the south, and extending to the Anas (Guadiana), the capital of which was Corduba (Cordova) or Hispalis (Seville); and Lusitania, between Cape St. Vincent and the Durius (Douro), and nearly corresponding to the modern Portugal, the capital of which was Augusta Emerita (Mérida). The country became so thoroughly Romanized that it was one of the principal seats of Roman civilization and literature. Christianity was early introduced, and in the time of Constantine the Christianization of the entire country was completed. The decay of the Roman empire called several German tribes to Spain, who encountered but feeble resistance. The Suevi founded an empire in the N. W. part, in the province of Gallæcia; the Alani occupied Lusitania; and the Vandals settled in the southern province of Bætica, which was called after them Vandalusia (now Andalusia). The Romans called to their aid the Visigoths, who had a powerful empire in S. W. France, already extending across the Pyrenees as far as the Ebro. King Wallia of the Visigoths in A. D. 418 destroyed the empire of the Silingi, a tribe of the Vandals, in S. Spain, and so reduced the power of the Alani that they fused with the Vandals, who in their turn in 429 left under Genseric for N. Africa, where they founded a great empire. The Visigoths soon subdued the whole of Spain with the exception of the northwest, which remained in the possession of the Suevi till 585, when their empire was destroyed by the Visigothic king Leovigild. One of the greatest kings of the Visigoths was Euric, who in 471 put an end to the dominion of the Romans, and gave to Spain the first written laws. Under Reccared I. the Visigoths, who until then had been Arians, adopted the Catholic faith (589), a step which greatly facilitated the thorough coalescence of the Gothic, the Latin, and the native Spanish elements of the population into one Spanish nationality, with a general prevalence of the Latin element. The constitution of the Visigoths was an elective monarchy, which proved to be a prolific source of violence, assassination, and civil war, and finally led to the destruction of their kingdom. The family of Alaric, which had been dissatisfied at a new election, called the Arabs, who had an empire on the N. coast of Africa (in Mauritania, whence they were called Moors), into Spain, and King Roderic fell in the great and protracted battle at Jerez de la Frontera (July, 711). The Arabs, under the leadership of Tarik, Musa, and others, completed within a few years the subjugation of the country, with the exception of the mountainous districts Asturias, Cantabria (E. of the preceding), and Navarre, where a Gothic prince, Pelagius (Spanish, Pelayo), was elected king, and main-

tained himself successfully against the invasion of the Arabs. The conquered part of Spain became at first a province of the eastern caliphs. When the Ommiyade line of caliphs was overthrown by the Abbassides, Abderrahman, who had escaped the massacre of his family, was invited to Spain, and in 756 established an independent Ommiyade dynasty at Cordova, which attained a high degree of prosperity, especially under Abderrahman III. (912–961). Agriculture, commerce, science, and art flourished, and the literary institutions of the Spanish Mohammedans were so celebrated that they were frequented by Christian students from all countries of Europe. The Jews became very prosperous, and it was in Spain that the mediæval Hebrew literature reached its highest development. The language and customs of the Moors became generally predominant; the Christians were deprived of their political rights, yet retained the free exercise of their religion. Early in the 11th century the caliphate of Cordova became the prey of internal revolutions, and in 1031 it disappeared altogether, numerous kingdoms being founded on its ruins. During the three centuries of its existence the Christian power had been steadily extending in the north of the peninsula. The little kingdom which maintained itself under Pelayo in the mountainous districts of N. W. Spain was at first limited to the district of Oviedo, and therefore called the kingdom of Oviedo. The second successor of Pelayo, Alfonso I., the Catholic, conquered Galicia, with a part of Leon and Castile, and assumed the title of king of Asturias. The whole of Leon was conquered by Alfonso III., the Great (abdicated 910), whose son Ordoño II. transferred his residence to the city of Leon, and called his dominion the kingdom of Leon. N. E. Spain was conquered by Charlemagne, and became known as the Marca Hispanica, but the Frank dominion was of short duration. Navarre appears as an independent state in the 9th century, and gradually rose to be a powerful kingdom. Near the sources of the Ebro and the Pisuerga arose the kingdom of Castile, at first a small republic, consisting of some forts and a few towns. If it was ever fully subdued by the Moors, it threw off their yoke very soon, for as early as 759 there appears a count of Castile. Its territory was soon enlarged, but for some time it was subject to Leon, until in 961, under Fernando Gonzales, it recovered its independence. Its rulers soon assumed the title of king, and in 1037 Ferdinand I., the Great, united the kingdom of Leon with Castile, which was henceforth the most powerful Spanish state. Catalonia was ruled by counts, the most prominent being those of Barcelona, who early in the 12th century became the sole rulers. Aragon, which had formed a part of Navarre, became an independent kingdom under Ramiro I. in 1035, and in 1137 it was united with Catalonia. Portugal was made a distinct county by Alfonso VI. of Castile about 1095, and in 1139 was erected into a kingdom. The most important of the Moorish states which arose out of the caliphate of Cordova were Toledo, Valencia, Murcia, Saragossa, and Seville. The last became very powerful under the Abadite princes, and comprised Andalusia, Cordova, Algarve, and other territories. In the latter half of the 11th century the Christians found a brave leader in Alfonso VI. of Castile, whose reign was rendered brilliant by the romantic exploits of the Cid. Alfonso destroyed the kingdom of Toledo (1085), made its capital his residence, and named his conquest New Castile. Toward the close of the 11th century the Moorish sect of the Almoravides, who had established their dynasty in Morocco, invaded Spain, overthrew the kingdom of Seville, and rapidly extended their sway over the other Moorish territories. But before the middle of the 12th century a new revolution in Africa raised the sect of the Almohades to power, and the Almoravides of Spain succumbed. The Christian princes, who like the Mohammedan rulers had constantly warred against each other, resolved to unite their forces in a common effort, and in 1212 Alfonso IX. of Castile, with the kings of Aragon and Navarre, annihilated the power of the Almohades in the great battle of Navas de Tolosa in the Sierra Morena. Their empire fell to pieces, the new states were successively subdued by the Christians, and before the close of the century Moorish dominion had been restricted to the kingdom of Granada, which paid homage to Castile. Granada continued for two centuries a great and populous state. Weakened by continual wars with Castile and by internal dissensions, it finally, after a desperate conflict, succumbed under the famous Boabdil to Ferdinand and Isabella. Among the Christian states of Spain, Aragon and Castile became the most powerful, and in the course of time absorbed all the others. Pedro I. of Aragon conquered the principality of Huesca; Alfonso I. (in 1118) Saragossa, which he made his capital; Alfonso II. and Pedro the Catholic likewise enlarged the empire; James (Jaime) I., the Conqueror, wrested from the Moors the Balearic islands and the kingdom of Valencia; Pedro III. occupied Sicily in 1282; and Alfonso V. united Naples with his kingdom. But, while enlarging its territory, Aragon suffered at home almost continually from civil broils and plots, from contests between the grandees and the kings, and from oppression of the people by taxes. It was, however, the first Christian state in which the third estate obtained a legal position. (See Aragon.) When the Catalonian line of princes became extinct, the cortes of Aragon in 1412 elected Ferdinand, infante of Castile, their king, and his descendants ruled the country until the latter part of the 15th century, when the marriage of Ferdinand V., the Catholic, of Aragon, with Isabella of Castile, consolidated all Christian

Spain into one kingdom. Among the more prominent kings of Castile are Ferdinand III. (1217–'52), who by successful wars against the Moors annexed Jaen, Cordova, and Seville to his dominions; his son Alfonso X., the Wise (1252–'84), a patron of science and art, and himself a great scholar, but a weak ruler, under whom, while he was striving for the imperial crown of Germany, the Moors made new conquests in the southern part of Spain; Alfonso XI. (1324–'50), who broke the power of the Moors; and his son Pedro the Cruel, who, after a distracted reign, perished in 1369. In Castile the towns possessed fewer rights and attained less prosperity than in Aragon, while the privileges and the power of the clergy and the nobility were more extensive. In the 15th century, during the reign of minor princes, the clergy and nobility usurped so much of the royal prerogatives, that when Isabella (1474–1504) ascended the throne, royalty was almost powerless. Ferdinand the Catholic united the dignity of grand master of the three Castilian orders of knights for ever with the Spanish crown, obtained from the pope the right of nominating all bishops, expelled the Jews from the Spanish soil, and reorganized the inquisition. (See Inquisition.) The subjugation of the kingdom of Granada, the last Moorish possession in Spain (1491–'2), completed the political consolidation of the kingdom; while the conquest of Naples (which had been separated from the crown of Aragon) by Gonsalvo de Cordova, and still more the discovery of America by Columbus, and the subsequent occupation of large portions of North, Central, and South America by Spanish generals, soon raised the new kingdom of Spain to the front rank among the powers of the earth. But the expeditions to America led to a neglect of the native soil, and the expulsion of the Jews and of the bulk of the Moors proved a fatal blow to the flourishing industry of Spain. Ferdinand, who had survived his son-in-law Philip I. of Castile, was succeeded in 1516 by his grandson Charles I., who permanently united Castile and Aragon, inherited the Netherlands from his paternal grandfather, the German emperor Maximilian of Hapsburg, was elected emperor of Germany (as Charles V.), and conquered Milan. At the beginning of his reign serious insurrections broke out in Valencia and Castile, where the people demanded a more liberal constitution; but they were soon quelled, and resulted in the abolition of the principal rights of the towns, the restriction of the powers of the cortes, and a stronger attachment of the clergy and nobility to the crown. The constitutional privileges or *fueros* of the Basque provinces were, however, reconfirmed. The conquest of Mexico by Cortes, and of Peru and Chili by Pizarro and Almagro, poured immense riches into the royal treasury; but the wars of Charles against Francis I. of France, against the Protestants of Germany, against the people of Ghent in the Netherlands, against Pope Clement VII. in Italy, and against Tunis and Algiers, exhausted the revenues of the country, burdened the people with enormous taxes, and required the contracting of a heavy debt. Under the reign of his son Philip II. (1556–'98) the vast monarchy began to decay. Philip, under a claim of succession by inheritance, conquered Portugal, which from 1581 to 1640 remained united with Spain; but this conquest, together with the war against the revolted Netherlands, a brilliant naval warfare against the Turks, the unfortunate naval struggle with England, in which the "invincible armada" was destroyed and Cadiz captured by the English, and the extravagance displayed in the building of the Escurial, exhausted the strength of the country. The despotic measures adopted by the inquisition for crushing out Protestantism and the remnants of the Moors (Moriscoes), and by the king for destroying still more thoroughly the ancient privileges of the people, had in great part the desired effect, but also completed the ruin of Spanish commerce, agriculture, and industry. Literature and art, however, continued to flourish, and the Spanish language and fashions controlled the courts of Europe. The imbecile and fanatical Philip III. (1598–1621) left the reins of government to his favorite, Count Lerma, who squandered the revenues of the state, and drove the last of the Moriscoes, 600,000 in number, out of Spain. Under Philip IV. (1621–'65) Portugal recovered its independence; Catalonia was devastated for 10 years by a civil war; the Dutch infested the Spanish possessions in America, especially Peru; three fleets were destroyed by gales, diseases, and the enemy; the Protestant Netherlands were abandoned for ever; insurrections broke out in Naples and Sicily; and the enmity between Olivarez, the Spanish minister, and Richelieu, involved Spain in a war with France, by which the former lost Roussillon. Under Charles II. (1665–1700) another disastrous war was waged against France, and the population of Spain decreased to 8,000,000. The death of Charles, with whom the Spanish house of Hapsburg became extinct, occasioned a war for the succession to the Spanish throne, which both the brothers-in-law of Charles, Louis XIV. of France and Leopold I. of Austria, tried to secure for princes of their respective families. Charles, in a second will, appointed Philip of Anjou, grandson of Louis XIV., sole heir of all the Spanish monarchy; but Germany, England, and Holland contested the validity of the will, and for 13 years resisted the claim of Philip to the Spanish throne. (For the principal events of the war of Spanish succession in the wider sense, see Philip V., Charles VI. of Germany, Louis XIV., Eugene, and Marlborough.) The allies won several signal victories; yet Philip V. finally maintained himself on the throne, although in the peace of Utrecht (1713) he was obliged to cede Naples, the island of Sar-

dinia (a conquest of Aragon), Milan, and the rest of the Netherlands to Austria, Sicily to Savoy, and Gibraltar and Minorca to England. Under his reign Aragon, Valencia, and Catalonia lost the last of their constitutional rights. The great affairs of the state were managed by the queen, Elizabeth Farnese, and her minister, Cardinal Alberoni. In Italy, Naples and Sicily were conquered by the infante Carlos in 1734-'5, and Parma gained for the infante Philip in 1748. Philip's son Ferdinand VI. (1748-'59) was disabled by melancholy from taking active part in the government. He was succeeded by his half brother Charles III. (1759-'88), previously king of Naples, with whose reign a better era began to dawn. Having signed the Bourbonic family compact with France in 1761, he was involved in the French-English war, in which, as well as in an expedition against Morocco and Algiers in 1775, and in the expensive siege of Gibraltar during a second war with England, the Spanish arms were not successful; but the internal prosperity of the country was greatly promoted by the wise administration of the king, who was assisted by a number of enlightened statesmen, as Aranda, Campomanes, Olavidez, and Florida Blanca; agriculture, commerce, and trade began to revive; and the population during his reign showed a considerable increase. The power of the inquisition was greatly restricted, the Jesuits were expelled from all the Spanish dominions (1767), and the boundaries of the empire enlarged by the addition of Minorca and Louisiana. He was followed by his son Charles IV. (1788-1808), who at first continued the reformatory policy of his father, but after 1792 gave himself up to the pernicious influence of Manuel Godoy, duke of Alcudia. At first Spain joined the alliance against the French republic, but was soon compelled to conclude the inglorious peace of Basel (1795), by which Santo Domingo was ceded to France. In 1796 Godoy entered with France into the offensive and defensive league of San Ildefonso, and declared war against England. In 1797 the Spanish fleet was defeated near Cape St. Vincent, Minorca and Trinidad were occupied by the English, and all the ports of Spain blockaded. Spain suffered so much from this war, and the financial embarrassment of the country became so great, that Godoy resigned his position as prime minister, although he retained in fact a controlling influence in state affairs. In 1800 Spain ceded Louisiana to France, and in 1801 commenced, at the instigation of Bonaparte, a war against Portugal, the ally of England, which was terminated by the peace of Badajoz, and resulted in the cession of Olivença by Portugal to Spain. By the treaties of Lunéville and Amiens, Spain ceded Trinidad to England, Parma was annexed to the Cisalpine republic, and the prince of Parma, a descendant of the royal house of Spain, was made king of Etruria. On the reopening of the war between France and England in 1803, France demanded, in accordance with the league of San Ildefonso, the assistance of Spain, which, desirous of preserving a neutral position, agreed to pay to France a monthly subsidy of 4,000,000 piasters. The capture of several Spanish vessels by the English compelled Spain to declare war against England, Dec. 12, 1804. At Trafalgar, Oct. 21, 1805, the combined French and Spanish fleets were totally defeated by Nelson, and Spain alone lost 12 ships of the line. The misery which these unfortunate wars brought upon Spain led to the formation of a powerful opposition to Godoy, who made some feeble and fruitless efforts to extricate his country from the alliance. The success of Napoleon in the war against Prussia thwarted these efforts; he demanded and obtained from Spain two auxiliary armies, one of which, consisting of 16,000 men, was sent to Denmark, the other to Tuscany. Spain had also to submit to the disgraceful treaty of Fontainebleau, in consequence of which French troops were marched into the country. An insurrection compelled Charles IV. to abdicate in favor of the prince of Asturias (March 18, 1808), who ascended the throne as Ferdinand VII. Soon after, however, in a letter to Napoleon, he represented his resignation as compulsory, and revoked it. Both father and son courted the patronage of Napoleon, who, accepting the office of arbiter, invited them to Bayonne, and there extorted from both, as well as from the infantes Don Carlos and Don Antonio, a resignation of their claims to the Spanish throne. Napoleon then called a junta of 150 Spanish and American delegates for the purpose of forming a new constitution, and on June 6, 1808, declared his brother Joseph king of Spain and the Indies. The new constitution was adopted and sworn to by the king and the delegates, July 6. On July 9 Joseph departed for Spain, where insurrections had already broken out in Navarre, Aragon, Estremadura, Castile, Leon, and Galicia. England, on July 4, made peace with "the Spanish people," recognized Ferdinand VII. as king of Spain, and vigorously supported the insurrection of the Spaniards, which was under the direction of a central junta. The junta, at the head of which was the aged ex-minister Florida Blanca, called into the field half a million of combatants, under Palafox, Castaños, Romana, Ballesteros, and other national leaders, who were supported by English armies under Moore, Baird, Wellington, Beresford, and others. A fierce guerilla warfare was waged throughout the country; Saragossa, Gerona, Cadiz, Tarragona, and Valencia were heroically defended. Until 1812 the war was carried on with varying success; yet the greater part of Spain fell into the hands of the French, who were commanded by Suchet, Soult, Masséna, Marmont, Ney, Macdonald, and other generals, and the Spanish patriots and the English maintained themselves only in the western provinces and in Portugal.

But the failure of Napoleon in Russia was soon followed by a retreat of the French from Spain. Soult with 30,000 French troops was recalled; the brilliant victory of Wellington at Vitoria (June 21, 1813) forced the French army to fall back to the other side of the Pyrenees. Only a few strong places remained in their possession, until the bloody victory of Wellington at Toulouse (April 10, 1814) and the capture of that city successfully terminated the Spanish war of independence. The cortes, which in January, 1810, had fled from Seville to Cadiz, completed a new constitution, March 18, 1812. The regency, which was recognized by England and Russia, at once took the oath to acknowledge it. After the termination of the war, the cortes invited Ferdinand VII., who had been set free by Napoleon, to return to Spain and take an oath to support the constitution. Ferdinand returned, but went to Valencia, and declared the constitution null and void. He announced at the same time his intention, not to restore despotism, but to introduce another constitution on a liberal basis. This promise was not fulfilled; the inquisition was revived, despotism was restored, and most of the reforms introduced under Charles III. were annulled. Florida was sold for $5,000,000 to the United States, and the attempts to reconquer the revolted colonies in America proved miserable failures. On Jan. 1, 1820, a military insurrection, under Riego, broke out for the purpose of restoring the constitution of 1812. It spread with great rapidity; several generals, as O'Donnell and Freyre, who were sent out for its suppression, joined the insurrectionists; and in March the king was compelled to proclaim the constitution of 1812, and to convoke the cortes. A new ministry was formed, the press declared free, the inquisition abolished, and within a few days the new order of things was acknowledged throughout Spain. The suppression of a part of the convents and other resolutions passed by the cortes, which met in July, provoked the formation of an "apostolical junta," which demanded the restoration of the absolute power of the king, of the convents, and of feudal institutions. Even a regency was appointed by the apostolical party at Seo de Urgel, in Catalonia; but the troops of the government drove the regency into France in November, 1822, and dispersed all the guerilla bands in the northern provinces in February, 1823. In the mean time France, at the congress of Verona (1822), agreed with the courts of eastern Europe upon an armed intervention in Spain. The Spanish government was called upon to restore the royal sovereignty and to change the constitution; and compliance being refused, a French army of 100,000 men, under the duke of Angoulême, marched into Spain in April, 1823. The Spanish government opposed to them four corps under Ballesteros, Mina, O'Donnell, and Morillo, but most of them were soon overpowered and capitulated; Riego, who maintained himself longer than most of the other generals in the field, was made prisoner and hanged. The king was compelled to follow the cortes to Seville, and from thence to Cadiz; but a new regency at Madrid, in the name of the "imprisoned king," restored political absolutism, together with the convents. When Cadiz was closely invested and bombarded by the French, the cortes restored to the king his absolute power, Sept. 28. Ferdinand VII. at once revoked all the decrees of the constitutional government from March 7, 1820, to Oct. 1, 1823, and confirmed those of the regency. All persons suspected of liberalism were persecuted with great rigor; the municipal rights of the communities were abolished; and a treaty was concluded with France, which provided for a continuance of the French occupation. Still a great part of the absolutist party considered the king as not sufficiently energetic, and formed a coalition for elevating to the throne his brother Don Carlos. Several insurrections broke out in 1825 and 1826, but they were soon quelled. At the same time Spain was compelled to abandon its last position on the mainland of America, Jan. 22, 1826. In 1830 Ferdinand was prevailed upon by his wife, Maria Christina, a Neapolitan princess, to abolish by the pragmatic sanction of March 29 the Salic law of the Bourbon family. In consequence of this change his daughter, the infanta Isabella (born Oct. 10, 1830), became heir to the throne, in place of his brother Don Carlos. In September, 1832, the apostolic party extorted from the king, who was dangerously ill, a revocation of the pragmatic sanction of 1830; but the intrigue was soon discovered, the influence of the party broken, and Maria Christina appointed regent of Spain for the time of the king's illness (October, 1832). She surrounded herself with a ministry of *moderados*, and tried to effect a reconciliation with the liberals in order to break the power of the Carlists. Don Carlos himself entered a protest against his exclusion from the throne, which was sustained by the Bourbonic courts of Italy. The death of Ferdinand VII., Sept. 29, 1833, was the signal for a general civil war. Don Carlos was proclaimed in the Basque provinces as Charles V., and was supported by a majority of the clergy and the country people throughout the kingdom; Maria Christina had the joint support of the moderados and the liberals. At first the Carlists, under the command of Zumalacarreguy, were successful, and the government of Christina implored the aid of England and France, which allowed recruiting within their states for the Spanish army. Soon afterward an army of 10,000 men was enlisted in England to join the royal troops. The cause of the Carlists began to decline with the unexpected death of Zumalacarreguy, June 25, 1835, and still more when Espartero in 1836 assumed command of the royal army in the northern provinces. The government, in the mean while, was compelled to make new con-

cessions to the radical wing of the progressive party (*exaltados*), and to adopt in 1837 the so-called modified constitution of 1812. The Carlists were finally overpowered in 1839, when Don Carlos fled to France. Cabrera maintained himself until July, 1840, when he also fled to France, and the Carlist war was at an end. Yet another revolutionary movement broke out in the same year, when the cortes passed a new *ayuntamiento* law, which abolished the former municipal rights of the Spanish towns. Maria Christina found it necessary to appoint Espartero, the leader of the movement, prime minister; soon afterward (Oct. 12) she resigned, and, with the chiefs of the moderados, embarked for France. The cortes in 1841 appointed Espartero regent during the minority of the queen, and Argüelles, an old constitutionalist of 1812, her tutor. The administration of Espartero did more to promote the prosperity of the country than any other before or after him. New roads and canals were constructed, mining was encouraged, and industry and trade were put on a firmer basis; and the functions of public officers were never discharged with greater integrity. But the sale of the ecclesiastical property had provoked the almost unanimous opposition of the Spanish clergy, who, in union with the *moderados* and the *absolutistas*, were strong enough to harass Espartero by insurrections during the entire period of his administration. In May, 1843, an open rupture between Espartero and the cortes, although a majority of them were *progresistas*, was at once followed by a general insurrection throughout Spain, at the head of which were the leading generals of the moderados, as Narvaez and O'Donnell, who had returned from France. Toward the close of July Espartero embarked at Cadiz for England. In October the cortes declared the queen of age, who in the next year formed a ministry of moderados, under the presidency of Narvaez. Christina was recalled from France, her secret marriage with Muñoz, formerly one of her body guards, publicly announced, and negotiations commenced with the pope, who had denounced the sale of church property as robbery. In the cortes which met in October, 1844, the moderados had a majority, and in the constitution which they adopted (the constitution of 1845) the rights of the cortes were limited, and the trial by jury for offences of the press and the national militia were abolished. The subsequent history of Isabella II., who in 1846 married her cousin, Don Francisco de Asis, is especially noted for the frequent change of her ministers, mostly brought about by palace intrigues. In 1847 the queen yielded for a time to the counsels of her favorite, Gen. Serrano, and appointed a ministry of progresistas, which promulgated a general amnesty and conferred on Espartero, whom they recalled from England, the dignity of a senator. But before the end of the year the moderados regained the control of the state under the energetic leadership of Narvaez, who showed a conciliatory spirit, maintained the amnesty, and made no objection to the return of Espartero. Two illicit expeditions against Cuba, in 1850 and 1851, which were prepared by Cuban refugees in the United States, and met with great encouragement in the southern states of the Union, and subsequently the declarations of the American democratic party in favor of an acquisition of Cuba by the United States, disturbed the relations between the two governments. The relations with the papal court were settled on a friendly footing by the concordat of 1851. Narvaez resigned in 1851, and till 1854 short-lived and weak ministries succeeded each other, most of which had reactionary tendencies. In 1854 the progress of illiberal legislation, the financial operations of Maria Christina, her husband Muñoz, and the banker Salamanca, who had wrongfully obtained the most important railroad concessions, and the imposition upon the country of a compulsory loan of 180,000,000 reals, led to a military insurrection, one of the leaders of which was Gen. O'Donnell, who called on all liberal parties to unite and restore the constitution of 1837. On July 24 the queen saw herself compelled to charge Espartero with the formation of a new government. Constituent cortes were called, in accordance with the law of 1837, which met in a single chamber, and elected Espartero their president, Nov. 28; but two days later he was again appointed prime minister. The cortes restored in the main the liberal constitutions of 1812 and 1837, and declared themselves in favor of religious toleration, and for the sale of the church property. A large minority demanded the one chamber system, and that the decrees of the cortes should not need the sanction of the crown. The ascendancy of liberalism lasted until July, 1856, when, reactionary influences having again prevailed in the palace, Espartero resigned, and O'Donnell was appointed prime minister. An insurrection in Madrid and the other large cities was suppressed, and the entire kingdom declared in a state of siege. On Aug. 15 the national guard was dissolved, and gradually the illiberal legislation of 1845 restored, especially since Narvaez had become prime minister. The sale of church property was inhibited, and the concordat of 1851 restored. The church property question was finally adjusted by a convention with Rome, on Aug. 25, 1859; and the Spanish government became the strongest supporter of the temporal sovereignty of the pope. In 1858 Spain united with France in sending an expedition against the emperor of Anam, which conquered part of the coast of that country. At the close of 1859 war was declared against Morocco on account of Moorish piracies, and an army under O'Donnell was sent into Africa. After several indecisive conflicts the Moors were defeated, Feb. 4, 1860, near Tetuan, which

was captured, and on April 27 a treaty of peace was signed in which the sultan agreed to pay an indemnity of 400,000,000 reals, and to accord to Spanish trade the same rights as were enjoyed by the most favored nations. Diplomatic relations with Mexico had been broken off in 1857 on account of outrages on Spanish subjects and the non-payment of Spanish claims. Negotiations with France and England, which complained of similar grievances, led in 1861 to the conclusion of a tripartite treaty, in accordance with which the three governments toward the close of the year sent an expedition against Mexico, to obtain satisfaction. The castle of San Juan de Ulloa and Vera Cruz surrendered to the Spanish squadron under Gen. Gasset without a struggle (Dec. 14–17); but the project of the establishment of an empire under Maximilian being disapproved of, the Spanish forces were withdrawn in May, 1862. In 1860 a Carlist insurrection was incited by Gen. Ortega, governor of the Balearic islands, who proclaimed as king the count de Montemolin, eldest son of Don Carlos. The attempt failed, Ortega was captured and shot, and the count de Montemolin was forced to renounce his claim to the throne; but soon after he repudiated his abdication at Cologne. He died at Trieste on Jan. 13, 1861, when his brother Don Juan asserted his right to the Spanish crown. In the same year Spain resumed her authority over the republic of Santo Domingo on the invitation of President Santana, who despaired of allaying internal dissensions. Troops were sent thither, but in 1863 an insurrection broke out, which resulted in the relinquishment of the country by Spain in 1865. In 1864 war was declared against Spain by Peru in consequence of the seizure by the former of the Chincha islands. Chili joined Peru in 1865, and the war continued till 1866, when the Spanish forces were withdrawn from the Pacific. (See Chili, and Peru.) The misdeeds of Queen Isabella's administration and her own personal misconduct caused widespread dissatisfaction and led to numerous insurrections in 1865–'8, and resulted in the defeat of the royal army at Alcolea, Sept. 28, 1868, and the flight of the queen to France. A provisional government was established, presided over by Generals Serrano and Prim and Señor Olózaga. These events were immediately followed by an insurrection in Cuba. (See Cuba.) During 1869 several republican insurrections against the provisional government were suppressed with much bloodshed, and the cortes voted by a large majority against a republic and for a regency, which was established on June 15, with Serrano at its head. Violent discussions then took place concerning the choice of a king. After the rejection of the candidacy for the throne by several princes, the provisional government proposed to the cortes in July, 1870, the election of Prince Leopold of Hohenzollern-Sigmaringen; but he declined becoming a candidate in consequence of the strong opposition of France, which resulted in the Franco-German war. Meanwhile republican agitation was renewed in the provinces, but on Nov. 16 the cortes elected for king Amadeus, duke of Aosta, the second son of King Victor Emanuel of Italy, who accepted the crown on Dec. 4. On Dec. 28 Marshal Prim was mortally wounded by assassins in his carriage in the streets of Madrid, and two days after Amadeus landed at Cartagena. He endeavored to rule the country as a constitutional monarch; but the dislike of the Spaniards for a foreign prince, and the demoralized condition of all parties, caused his utter failure. After a stormy reign, during which Sagasta, Topete, Serrano, and Zorrilla were the leading statesmen, he abdicated on Feb. 11, 1873, and the cortes established a government under the presidency of Estanislao Figueras. Meanwhile a Carlist insurrection, which had broken out in the north in 1872, began to develop itself. Don Carlos, son of Don Juan, who had renounced in his favor his hereditary rights in 1868, took command of the insurgents and proclaimed himself king under the title of Charles VII. Among the commanders under him were his brother Don Alfonso, accompanied by his sanguinary wife Doña Blanca, the curate Santa Cruz, Dorregaray, Elio, Saballs, Lozano, Tristany, and Lizárraga; but the old Carlist chief Cabrera finally declared for the Madrid government. The insurrection gradually spread over Navarre, the Basque provinces, Catalonia, Aragon, and even Valencia. On June 8, 1873, the cortes, having previously abolished slavery in Porto Rico, adopted and proclaimed a democratic federal republic by a vote of 210 to 2, and Señor Pi y Margall was chosen president of the executive power. He was succeeded on July 19 by Don Nicolas Salmeron, who was succeeded in turn on Sept. 7 by Don Emilio Castelar. But the republic had scarcely been established when the *intransigentes* and internationals began a series of revolutionary movements in favor of "cantonal sovereignty," and insurrections broke out in various cities, chiefly of the south and southeast, while the Carlists infested the north. Alcoy, where frightful atrocities were committed, Malaga, Seville, Cadiz, Granada, Valencia, and Murcia were easily reoccupied by the government troops under Pavia, Campos, and others (July and August); but Cartagena, in which Gen. Contreras led the insurgents, resisted for six months (July, 1873, to January, 1874). Here a portion of the Spanish fleet had fallen into the hands of the insurgents, with which they made piratical excursions against Almería and other towns of the coast. The blockade was, however, pushed forward with vigor, and a heavy bombardment finally compelled the surrender of the fortress, Contreras and other leaders escaping to the coast of Algeria. Less successful were the government troops under Moriones in the north, who failed to relieve Bilbao. Castelar

resigned on Jan. 2, 1874, when his ministry was found to be in the minority. On the following day Gen. Pavia, captain general of Madrid, dissolved the cortes with an armed force, and a new ministry was formed under the presidency of Gen. Serrano. Cartagena having been reduced shortly after his accession to power, Serrano personally took the command against the Carlists, who had taken Portugalete, and after considerable fighting with varying success around Sommorostro (March–May), Portugalete was retaken and Bilbao relieved. Marshal Concha, however, who succeeded Serrano in command of the army of the north, fell in battle before Estella in June, and in July Don Alfonso advanced with his Carlists as far as Cuenca. Puycerda, which the Carlists besieged, was relieved in August, and Irun in November. Serrano held the executive power until Jan. 9, 1875, when Alfonso, son of Isabella II., who had been proclaimed king by the armies of the centre and north and in Madrid, landed in Spain. The new king took the field against the Carlists in person, but with slight success. Subsequently, however, operations were resumed with greater vigor, and the Carlists were repulsed from St. Sebastian and before Vitoria, and forced back beyond the Ebro. Catalonia was almost entirely freed from them, and the capture of Seo de Urgel with its garrison (October) proved a demoralizing defeat. Many Carlist chiefs submitted, others fled into France, and still others were shot as traitors. At the close of 1875 the Carlist insurrection seemed to be on the point of succumbing to the forces of Alfonso XII.; but an empty treasury, the troubles caused by the *intransigentes* and by the acrimonious disputes of the different political factions in Madrid, and the still unsuppressed rebellion in Cuba, give little hope of a peaceful reign to the new king.—Among the best histories of Spain are those of Mariana (1601; with continuation by Sabau y Blanco, 20 vols., Madrid, 1817–'22), Bossi (8 vols., Milan, 1821), and Lembke and Schäfer (in the collection of Heeren and Ukert, 3 vols., 1831–'67). The most valuable illustrations of Spanish history in English are in the works of Prescott, Irving, Ticknor, Watson, Robertson, Coxe, Dunlop, Southey, Stirling, and Ford. Some of the more recent works on Spain are the following: Coello, *Reseña geográfica, geológica y agrícola de España* (Madrid, 1864); F. Garrido, *La España contemporánea* (Barcelona, 1865); H. M. Willkomm, *Das pyrenäische Halbinselland* (Leipsic, 1866); G. de Lavigne, *L'Espagne et le Portugal* (Paris, 1867); Ch. de Mazade, *Les révolutions de l'Espagne* (Paris, 1869); H. Ségoillot, *Lettres sur l'Espagne* (Paris, 1870); Augustus J. C. Hare, "Wanderings in Spain" (London, 1872); Baron Ch. Davillier, *L'Espagne*, illustrated by Doré (4to, Paris, 1873; English translation by J. Thompson, London and New York, 1875–'6); V. Cherbuliez, *L'Espagne politique*, 1868–1873 (Paris, 1874); N. L. Thieblin, "Spain and the Spaniards" (London, 1873; Boston, 1875); H. W. Baxley, "Spain: Art Remains and Art Realities; Painters, Priests, and Princes" (2 vols. 8vo, London, 1875); and H. J. Rose, "Untrodden Spain and her Black Country, being Sketches of the Life and Character of the Spaniards of the Interior" (2 vols. 8vo, London, 1875).

**SPAIN, Language and Literature of.** The Spanish language sprang from the vulgar Latin, which was introduced into Spain with Roman domination, and became prevalent throughout the peninsula. But vestiges still remained of ancient dialects and of idioms introduced by Phœnicians, Greeks, and Carthaginians, who founded colonies on the coast. The invasion of the Goths soon determined the corruption of the Latin; but as the conquerors had already been in extensive communication with the Romans, the corruption was not so complete as in some other provinces of the empire overrun by northern nations. Even after the Gothic rule was firmly established, the bishops of Rome retained much influence in the government, and through them the distance between the conquerors and the conquered was greatly lessened; and when they finally coalesced, the language of the latter prevailed, though somewhat disfigured. At the time of the Saracen invasion this adulterated Latin was the tongue in common use. After the destruction of the Gothic empire the national language was preserved in the fastnesses of the north, but in so corrupt a state that in the 9th century the Latin of books was no longer intelligible to any but the churchmen. This uncultured idiom was extended gradually by conquest to the parts occupied by the Moors, where it acquired many Arabic words, which contributed materially to its vigor and richness. Such was the process of formation of the Castilian tongue, in earlier times called the *Romance vulgar*. The Latin continued to be the language of the cloisters and the colleges, and in it were written most of the important works down to the 15th century, when it was superseded by the language of the people. The following are some of the more important changes in the formative part of the language. The vowels *e* and *o* of the accented penultima frequently develop into the diphthongs *ie* and *ue*, as in *tiempo*, *bueno*, *fuerte*, *puente*, from *tempus*, *bonum*, *fortem*, *pontem*. Harsh consonants show a tendency to soften, and combinations to change into single consonants, as in *abrir*, *saber*, *digo*, *agua*, *edad*, from *aperire*, *sapere*, *dico*, *aqua*, *ætatem*. Such combinations as *cl*, *fl*, *pl*, &c., are often changed into the liquid *ll*, as in *llave*, *llama*, *llano*, from *clavis*, *flamma*, *planus*; *ct* passes into *ch*, as in *noche*, *dicho*, from *noctem*, *dictum*; initial *f* is changed into mute *h*, as in *hacer*, from *facere*. These mutations occur in the accented penultima, and disappear generally with a transposition of accent, or with the addition of one or more syllables, as in

*tiempo*, *temporal*, *bueno*, *bonísimo*, *llamar*, *exclamar*, &c. The *d* in the middle of a word between two vowels has often been dropped, as in *creer*, *fiel*, from *credere*, *fidelis;* and a *b* or *d* is, as in cognate languages, inserted where *m*, *n*, or *l* would meet with *r*, as *nombre*, from *nomen; tendré*, future of *tener; saldré*, future of *salir*. The introduction of the strong gutturals *g* (before *e* or *i*) and *j* (or *x*) is to be ascribed to Teutonic influence. In words beginning with *s* followed by another consonant, a euphonic *e* is invariably prefixed, as in *estar*, *espiritu*, *escudo*, from *stare*, *spiritus*, *scutum*. *Ni*, *ne*, *nn*, and *gn* have been often changed into the liquid *n* (*ñ*), as in *España*, *entraña*, *año*, *leño*, from *Hispania*, *intranea*, *annus*, *lignum*. The inflections of the noun and the verb show a marked influence of the Gothic. The refined system of declension was too complicated for the northern barbarians; they used only one case ending for each of the singular and plural numbers, and this ending was supplied in the singular, not by the Latin nominative, but by the accusative, with the rejection of the consonantal ending *m*, and sometimes of the syllabic ending *em*. Thus the Latin *nix*, *dux*, and *virtus* pass into *nieve*, *duque*, and *virtud;* but the neuter nouns *corpus*, *tempus*, and *caput* form *cuerpo*, *tiempo*, and *cabo*. The loss of cases was remedied by the use of the article, not unknown to the Goths, and obtained from the vulgar Latin, in the shape of the demonstrative pronoun *ille* and the numeral *unus*. The verb also has lost some terminations, the place of which has been supplied, though imperfectly, by the more frequent use of the auxiliaries. The composition of the future (*amaré* instead of *amar he*, I have to love), and the expression of the passive voice by means of the auxiliary verbs, are the most remarkable instances of the influence of the Gothic. The words of northern origin are calculated to amount to about one tenth of the whole number, many of which refer to war and strife, or to peculiarities of the Teutonic race. From the Arabs, who maintained themselves on Spanish soil for nearly 800 years, the Spanish language received that oriental coloring which distinguishes it among the Romanic languages; but on words and forms the influence of the Arabic was slight. The sound of *z*, and of *c* before *e* and *i* (precisely that of *th* in the English *think*), is of Arabic origin; so are most of the words beginning with *al* (the Arabic article), some of which, as *almanaque*, *alcohol*, &c., have passed through the Spanish into all the modern languages of Europe. Among the numerous dialects simultaneously developed in the peninsula from the amalgamation of the Latin and the Gothic languages, the Castilian gradually gained the ascendancy, and has become established as the language of Spain. All the other dialects have perished in the course of time, with the exception of the Portuguese, which has become a separate language, and the Catalan, still spoken throughout Catalonia. The Basque, which is spoken in some of the northern provinces, is supposed by philologists to be the lineal descendant of the language most in vogue in the peninsula before the Roman invasion. The territory of the Spanish language is one of the most extensive in the world, embracing, besides Spain, all of the Spanish American republics, most of the West Indies, the Philippine islands, and small portions of Africa. The Spanish language has 27 letters or signs of as many distinct sounds. Two of these, the liquids *ll* and *ñ* (pronounced respectively like *li* in *Julia* and *ni* in *union*), are peculiar to it. The language is destitute of the sound of *z* in *zeal*, the Spanish *z* having always the *th* sound, and *s* the sharp sound as in *sun*. All letters are pronounced except *h*, and *u* in the combinations *gue*, *gui*, *que*, *qui*. The six vowels do not change in sound, like the English vowels, but have always the same pronunciation, which agrees with that of the Italian.—The substantives have only two genders, masculine and feminine; but the article has three forms, *el*, *la*, and *lo*, the last of which is used for changing adjectives into substantives, as *bueno*, good, *lo bueno*, that which is good. The plural is formed by adding to the singular either *s*, as *libro*, *libros*, or *es*, as *mes*, *ley*, *rubí*, pl. *meses*, *leyes*, *rubíes*. A declension proper does not occur, the inflections of the Latin having been lost, and being replaced by the use of prepositions, especially *de* and *á*. The Spanish is uncommonly rich in augmentative and diminutive terminations, which have gradually become the regular and very common means of adding to the original meaning of words the expression of great or small size, and feelings of admiration or contempt. The comparative is generally formed by prefixing to the positive the adverb *mas* (Latin *magis*, more), and the relative superlative by adding to the comparative the definite article; as *grande*, large, *mas grande*, larger, *el* or *la mas grande*, the largest. It has also the forms *mayor*, larger, and *la mayor*, the largest. It has retained from the Latin, like the kindred idioms of Italy and Portugal, an absolute superlative, formed by the addition of the ending *ísimo*. In the verb the subjunctive has two more tenses than the Italian and French languages, viz.: second conditional and future conjunctive. The number of conjugations has been reduced to three, as the formation of the infinitive by discarding the final *e* of the Latin infinitive effaced the distinction between the second and third Latin conjugations. The Spanish has also, almost alone among the Romance languages, a double set of auxiliary verbs, *haber* and *tener*, *ser* and *estar*, and uses the reflexive form of the verb more extensively than almost any other language of Europe. The most important of the native grammars are those of Lebrija, the first of all (Salamanca, 1492), the Spanish academy

(new ed., Madrid, 1868), Salvá, Rementería, and Bello; among foreign ones, those of Mallefille (Paris, 1846) and Chantreau (Paris, 1862). The best material for a historical grammar is to be found in *Orígines de la lengua española*, by Mayans y Siscar (Madrid, 1737 and 1873). The best dictionaries are those of the Spanish academy, Salvá, and Dominguez, purely Spanish; while among the bilingual dictionaries, the most valuable are those of Salvá and of Nuñez de Taboada, French-Spanish; of Seckendorf (3 vols., Hamburg, 1823), Spanish-German; and of Neuman and Baretti, revised by Velazquez de la Cadena (New York, 1852), Spanish-English. A comprehensive dictionary purely Spanish, etymological and *raisonné*, is now (1876) in course of preparation by a society of literati in Bogotá.—LITERATURE. The literary life of the Spanish people began under the rule of the Romans, when Spain became a chief seat of Roman civilization, and produced many of the greatest writers of Latin literature. After the Christianization of Spain and S. W. Europe in general, ecclesiastical literature found, next to Italy and Gaul, its most fertile soil in Spain. After the invasion by the Arabs, Arabian literature attained a high degree of prosperity, and the numerous Jews cultivated Hebrew literature with great success. The national literature of Spain begins in the 12th century with epic and didactic poems in Castilian verse, and resting on strong national sentiments as a basis. The first of these poems in age as well as in importance is the one commonly called the "Poem of the Cid," composed probably in the second half of the 12th century. Its subject is taken from the adventures of Ruy Diaz, surnamed *el Cid Campeador*, "the Lord Champion," the popular hero of the chivalrous age of Spain, and the defender of his country against the Moorish invaders. It is a rhymed narrative of events in chronological order, partly historical and partly romantic, told with Homeric simplicity; and, although its verse is rude and unadorned, the poem deserves to be ranked among the finest productions of the middle ages. Before this Spain had many popular songs, both lyric and epic, but we know little of their original form, as they were not committed to writing before the 16th centnry. The single manuscript which has preserved the "Poem of the Cid" contains three other poems, all like that anonymous, viz.: "The Book of Apollonius, Prince of Tyre," "The Life of our Lady, St. Mary of Egypt," and "The Adoration of the Three Holy Kings." These poems, as well as the rhymed "Lives of Saints" by the priest Gonzalo de Berceo (died about 1260), and the anonymous poem of "Count Fernan Gonzales," a hero of the earlier period of the Christian conflict with the Moors, who is to the north of Spain what the Cid became somewhat later to Aragon and Valencia, betray the influence of the ecclesiastical poetry of those times and of the chivalric poetry of France. They are written either in stanzas of Alexandrine verse or in the indigenous rhythm of the *redondillas*. Berceo is the earliest Spanish poet whose name can with certainty be connected with his works, which comprised more than 13,000 lines. A great impulse to the development of literature was given by King Alfonso the Wise of Castile, who substituted the Spanish language for the Latin in the courts, and ordered the laws to be published in it. Alfonso himself was a prolific author. In order to bring uniformity into the different systems of Spanish legislation, he compiled several codes of laws, the most celebrated of which has the title *Las siete partidas*. Several historical works, as a universal history of the world, a history of the crusades (*La gran conquista de ultramar*), and the celebrated *Crónica general*, a general history of Spain until the death of his father, were compiled under his direction. By these works, as well as by a translation of the Bible into Spanish, he became the creator of Spanish prose. Some of his poetical works have also considerable merit, though in general they are most remarkable for the variety of their metres, some of which were first introduced by Alfonso into Spanish poetry. The *Poema de Alejandro* of Juan Lorenzo Segura is a work of more than 10,000 lines on the life of Alexander the Great, filled with the fables and extravagances of the times. A continuation of it, called *Los votos del pavon*, is now lost. Alfonso found many imitators, as author and patron of literature, among the succeeding kings and the princes of the royal family. The most important of these works of royal origin is *El conde Lucanor*, by the prince Don Juan Manuel (died about 1347), a collection of 49 tales, anecdotes, and apologues, in the oriental manner, and partly taken from oriental sources. The most remarkable poet of the 14th century is Juan Ruiz, commonly called the archpriest of Hita (died about 1350). His works, embracing religious, pastoral, and erotic songs, fables, satires, and proverbs, consist of nearly 7,000 verses; and, although generally written in the four-line stanza of Berceo, they contain no fewer than 16 metrical forms, some of which are taken from the Provençal. The didactic tendency of the poetry of this period is apparent in the *Consejos y documentos al rey Don Pedro*, commonly called the book of Rabbi Don Santob, a curious poem, addressed by a Jew of Carrion to Pedro the Cruel on his accession to the throne, for the purpose of giving to him wise moral counsels. Another didactic poem is "The Dance of Death" (*Danza general de la muerte*), a kind of spiritual masquerade, in which the different ranks of society, from the pope to the young child, appear dancing with the skeleton form of death. The formation of a courtly school of lyric poets, after the model of the troubadours, had commenced under Alfonso X., who himself wrote lyric poems in the dialect of Ga-

licia. A flourishing school of Provençal troubadours was formed at the court of the counts of Barcelona, and a courtly school of Castilian poets sprang up at the court of the chivalric king John II. The poetry of this school, which moved within the narrow circle of courtly gallantry, lacked vigor and variety. Their works were collected in *cancioneros*, the oldest of which is that of Juan Alfonso de Baena, a converted Jew and one of the secretaries of John II. The most complete collection of the kind, the *Cancionero general* of Fernando del Castillo (Valencia, 1511), contains (in its 10th ed., 1573) the names of 136 authors, from the beginning of the reign of John II. to the time of the emperor Charles V. Among them were the marquis of Villena, the marquis of Santillana, and Juan de Mena, who in larger didactic poems tried to imitate classical and Italian models; Diego de San Pedro, who also wrote two love novels, *Cárcel de amor* and *Cuestion de amor;* and Guzman, who is also celebrated as a historian. In opposition to the Provençal and courtly schools, a more popular literature began in the second half of the 14th century, growing directly out of the enthusiasm which had so long pervaded the whole mass of the Spanish people; and it asserted for itself a place which in some of its forms it still maintains. This popular literature may be divided into four classes, ballads, chronicles, romances of chivalry, and the drama. Of most of the old ballads, as far as the time when they were thought worthy to be written, both authors and dates are unknown; about 1,000 are extant, unequal in length and still more in merit, which have been collected in the *Romancero general* (13 parts, 1605–'14). The chronicles, or the half genuine, half fabulous histories of the great events and heroes of the national annals, were originally begun by authority of the state, but they were always deeply imbued with the popular feelings and character. Some of them have already been referred to; other works of this class, which evince a steady progress of the historical prose, are the chronicles of Ayala and of Juan Nuñez de Villaizan, the "Chronicle of the Cid," the "Chronicle of the Travels of Ruy Gonzalez de Clavijo," and others. The first and most celebrated of the romances of chivalry is the "Amadis de Gaul," originally the work of a Portuguese gentleman of the 14th century, Vasco de Lobeira, but translated into Spanish by Montalvo between 1492 and 1504. The Portuguese original can no longer be found; but the Spanish version proved one of the most successful books of this branch of literature, establishing a high reputation in every country of Europe, and having, as Don Quixote said, descendants innumerable. The Spanish drama arose out of the representations so extensively connected with the festivals of the church during the middle ages. Among the best productions of this early period of Spanish literature belong the pastoral plays of Juan de la Encina and the celebrated dramatic novel of *Celestina* by Fernando de Rojas.—The second period of the national literature of Spain extends from the accession of the Austrian dynasty at the beginning of the 16th century to Cervantes. Under Charles I. (V. of Germany) Spain rose suddenly from a second class kingdom of Europe to be the most powerful empire of the world; and, as in the history of other countries, the political glory reflected itself in the rapid progress of literature. The union of Aragon and Castile led to the general adoption of the Castilian dialect as the commercial and literary language of the people. In consequence of the conquest of Naples by Gonsalvo de Cordova (1503–'4), and the increased intercourse of Spaniards with Italy, Italian literature, at that time the most advanced of Europe, began to have a marked influence on the poetry of Spain. The great Italian models, especially Dante and Petrarch, were imitated, and Italian measures, as the verses of seven and eleven syllables, and Italian forms, as the sonnets, *ottave rime*, and *canzoni*, were introduced. The first poet of this class was Juan Boscan Almogaver (died 1543), who made an experiment in Castilian of sonnets and the other forms of verse used by Italian authors. In most of these poems, although they are obvious imitations of Petrarch, a Spanish tone and spirit are perceptible, which rescue them from the imputation of being copies; yet there is an absence of the delicate and exact finish of the original. To a still greater perfection the best forms of Italian verse were carried by a friend of Boscan, Garcilaso de la Vega (died 1536), whose pastoral poems, unexcelled in Spanish literature, are remarkable for gentleness, a pleasing neatness of expression, and a rare sweetness of versification. His sonnets, elegies, and epistles are of less poetical value. Among those who aided most in the introduction and establishment of Italian metres was Diego Hurtado de Mendoza (died 1575). His sonnets are rougher than those of his predecessors, but his epistles (*cartas*) are rich in sentences, portraitures, and characteristics of great excellence. Though counted among the Italian school, he often gave himself up to the old *redondillas* and *quintillas*, and to the national tone of feeling and reflection appropriate to these ancient forms of Castilian verse. His satirical rogues' novel, *Lazarillo de Tormes*, a work of genius and a wholly original conception, became in Spain the foundation of a class of fictions essentially national, under the name of the *género picaresco* or rogues' style, which the "Gil Blas" of Le Sage has made famous throughout the world. Mendoza's history of the war against the Moriscoes in Granada is distinguished for manliness, vigor, truth, and picturesqueness of style. The Italian school of poets of this period includes also several Portuguese who wrote in the Castilian dialect, as Sa de Miranda (died 1558), the au-

thor of idyls, and Jorge de Montemayor (died 1562), the author of the celebrated pastoral novel *Diana*. The two greatest lyric poets that Spain has ever produced were Fernando de Herrera (died 1597) and Fray Luis de Leon (died 1591). Herrera wrote some excellent elegies, and the first classic odes in modern literature. The poetry of Luis de Leon is chiefly religious and deeply imbued with mysticism. The best of his poetical compositions are odes in the old Castilian measures, with a classical purity and vigorous finish before unknown in Spanish poetry. He ranks also among the greatest masters of Spanish eloquence for his prose, which is richer and no less idiomatic than his poetry. Less original, and at present less known, are Hernando de Acuña (died 1580), a lyric poet and skilful translator, and Gil Polo (died 1572), who ably continued and completed the *Diana* of Montemayor. Epic poetry was cultivated with but little success, and the attempts to sing the exploits of Charles V. made by Zapata (*Cárlos famoso*), Urrea, the translator of Ariosto (*Cárlos victorioso*), and Samper (*Carolea*), were failures. Cristóval de Castillejo (died about 1556), the most efficient among the early opponents of the Italian school, wrote novels and erotic songs, which are masterpieces; but the satire with which he inveighed against the innovators was generally too exaggerated to have any effect. Attempts made by Villalobos, Perez de Oliva, and others, to give a new impulse to dramatic poetry by the translation of old classics, were failures; but the epic elements of the old national novels led at the beginning of this period to the development of a truly national drama, of which Naharro (about 1517) must be regarded as the father. He was followed by Lope de Rueda, who, being both a dramatic writer and an actor, was the first to establish and regulate the Spanish stage; and by Juan de la Cueva (died about 1608), whose plays, mostly on historical subjects, are divided into four *jornadas* and written in various measures, including *terza rima*, blank verse, and sonnets, but chiefly in *redondillas* and octave stanzas. The two tragic plays of Gerónimo Bermudez, which treat of the sad history of Ines de Castro, are happy imitations of the old classic tragedy. In this period arose also the ecclesiastical plays (*autos sacramentales*) and the burlesque interludes (*entremeses y sainetes*) and preludes (*loas*), though their full development belongs to the following period. Prose literature consisted mostly of chivalric novels, formed after Italian originals, and without any intrinsic value or importance for the history of literature. Foremost among the prose writers were Mendoza and Luis de Leon, both of whom have already been named among the poets. Gerónimo Zurita, the author of a history of Aragon (*Anales de la corona de Aragon*), was the first of the Spanish historians as distinguished from the chroniclers, who in particular emancipated the historical literature of Spain from the monkish credulity of the old chronicles. Among the best specimens of didactic prose belong the dialogue of Oliva on the dignity of man (*Diálogo de la dignidad del hombre*) and the essays (*Discursos*) of Morales on subjects of practical philosophy and literature.—The golden era of Spanish literature begins in the second half of the 16th century with Cervantes (1547–1616), whose name and masterpiece are better known in foreign countries than those of any other Spanish author. His "Don Quixote," an ironical parody of the trashy literature of chivalric novels then in vogue, is the never equalled model of Spanish prose, the oldest classical specimen of romantic fiction, and one of the most remarkable monuments of modern genius. His *Novelas ejemplares* and his *Trabajos de Pérsiles y Sigismunda* inaugurated in Spain the literature of serious romantic fiction, in which he found many imitators, but none who equalled him. His *Galatea* is one of the best pastoral novels of Spain. The Spanish drama was raised to the elevated position which it occupies in the modern literature of Europe by the prolific Lope de Vega (1562–1635). He fixed its several modifications, and from his times we meet with the division into ecclesiastical and secular dramas (*comedias divinas y humanas*). The principal kinds of the secular drama were *comedias heróicas*, historical and mythological plays, and *comedias de capa y espada*, dramas with cloak and sword, the principal personages of which belong to the genteel portion of society, accustomed in Lope's time to the picturesque national dress of cloaks and swords. The ecclesiastical dramas were divided into *vidas de santos*, lives of saints, and *cantos* or *autos sacramentales*, plays at the Corpus Christi festival. In point of composition nearly all the dramas of Lope de Vega are alike; the unity of action, time, and place is little or not at all observed; acts and scenes barely connect the whole; language and representation are sometimes vigorous, sometimes weak, now noble, now common and coarse. The number of his dramas is almost fabulous, and is put by Perez de Montalvan, his intimate friend and executor, at 1,800 plays and 400 *autos*. He wrote also several epic poems, as *Jerusalen conquistada*, *Corona trágica*, &c., which were far inferior to his dramas, and were soon forgotten. His minor poems, among which are some of great merit, are almost innumerable. The number of poets at this time increased amazingly, though but few of them showed any originality. Among the lyric poets, the first, as far as their general influence was concerned, were the two brothers Argensola. Many of this class of writers belonged to the school of the *conceptistas*, who expressed themselves in metaphors and puns, alike in the pulpit and in poetry, or to that of the *cultos*, imitators of Gongora (1561–1627), who claimed for themselves a peculiarly elegant and cultivated style of composition, and who,

while endeavoring to justify their claims, ran into the most ridiculous extravagances, pedantry, and affectations. The essence of epic poetry was singularly misunderstood, as all epic poems were little more than versified history. Even the best work of the class, the *Araucana* of Alonso de Ercilla y Zúñiga (died about 1594), though not destitute of beautiful epic machinery, is condemned as tedious and prosaic by many critics; but a talent for animated description and portraiture, and a natural and correct diction, are conceded to its author. Of all kinds of poetry, the drama was cultivated most and with greatest success. A last attempt to write purely tragical plays was made by Cristóval de Virues, whose *Semíramis* and *Casandra* were, in true expression of tragic pathos and in vigorous dialogue, superior to all former efforts; but as the people had a decided preference for the national drama, in which, as in life, tragic scenes alternate with comic, it did not succeed. Higher than all former and later tragic poets stands Pedro Calderon de la Barca (1600–'81), one of the greatest dramatists that ever lived. To the originality and overflowing imagination of his predecessors he added a greater depth of reflection and a more careful execution in details. Female characters, in particular, were delineated by him more faithfully and more ingeniously than by any other Spanish poet. In elegance of language and versification he is also unequalled. The most prominent among his numerous successors were Francisco de Rojas, Agustin Moreto, Fragoso, Diamante, Antonio Hurtado de Mendoza, Juan de la Hoz, Antonio de Solis (better known as a historian), and Agustin de Salazar y Torres, who inclines toward the "cultivated style." The decline of Spanish literature shows itself in the writings of Francisco de Quevedo y Villegas, the most learned writer of his times, some of whose works, however, as his burlesque sonnets and his prose satires, are among the best of their kind in the Spanish language. Exaggeration and affectation vitiate the otherwise unparalleled erotic songs of Estéban Manuel de Villegas. The corruption of Spanish prose was hastened by the constant stream of bad and shallow novels, in which branch of literature the rogues' novel, *Guzman de Alfarache*, by Mateo Aleman, deserves an honorable mention. The only historians of note were Mariana (*Historia de España*) and Solis (*Conquista de Méjico*).—The fourth period, which begins with the accession of the Bourbon family at the beginning of the 18th century, embraces the collapse of the old national literature, the intrusion of foreign elements, their temporary victory over the old Spanish, and the final attempts to regenerate the old native element, and to fuse it with the best elements of modern European civilization. The first prominent advocate of the French element was Ignacio de Luzan, who in his *Poética* (1737) applied the rules of French critics to native literature, and in his own poems tried to substitute brilliancy for genuine poetry. He was principally opposed by Garcia de la Huerta, whose *Rahel* and *Agamemnon* were written in the old Spanish forms, and were received, in spite of the objections of Gallicizing critics, with immense applause. A middle course was pursued by the school of Salamanca, which endeavored to avoid the excesses of both parties and unite their merits. Its proper founder was Melendez Valdez (1754–1817), a poet of eminent talents, whose works exceed all that had been produced in Spain since the disappearance of the great lights of the 16th and 17th centuries, and were received with general enthusiasm as the dawn of a brighter period. Under the influence of the Salamanca school were also Iglesias, Noroña, Quintana, Cienfuegos, Arriaza, and Gallego, who like Valdez remained thorough patriots in sentiment, though not disdaining to follow great French, Italian, and English models. The liberal and patriotic movements of 1812, 1820, and 1834 exercised a very favorable influence on the invigoration of the Spanish mind and the progress of literature. Their fruit is to be seen in the works of Xérica, Lista, Martinez de la Rosa, José Joaquin de Mora, Ángel de Saavedra, and Breton de los Herreros. The number of recent poets is very large; among the best of them are Tapia, Maury, Juan Bautista Alonso, Jacinto de Salas y Quiroga, Espronceda, Serafin Calderon, Zorrilla, Hartzenbusch, R. de Campoamor, Santos Lopez Pelegrin, the satirist Villergas, and Gertrudis Gomes de Avellaneda, a native of Cuba. The modern age is least successful in epic poetry, the only notable attempt in this class of composition being the unfinished *Diablo mundo* of Espronceda. Better results have been obtained by a recultivation of the old romance and fable, the first impulse to which was given by Saavedra, who has been followed by Mora, Zorrilla, Gregorio Romero y Larrañaga, Manuel de Santa Ana, and others. In dramatic poetry, Leandro Fernandez Moratin, a chief representative of the classic school of France, secured for himself a permanent place on the national stage, and for the school to which he belonged a great influence, which lasted until in France the romantic school became powerful. The works of that school, partly in translations, partly in imitations, controlled for some time the stage of Madrid, but were opposed by Breton de los Herreros, Martinez de la Rosa, Tapia, Saavedra, and more recently by Gil y Zárate, Hartzenbusch, Gutierrez, Escosura, Zorrilla Moral, Trueba, and others. A reformation of prose literature, which had been reduced by the school of the *cultos* to the lowest ebb, was prepared by the Benedictine Feyjoó, who returned to the simplicity of the classic models of Spain, and by the Jesuit Isla, who in his satirical novel *Fray Gerundio* ridiculed the trivial and bombastic pulpit eloquence of his times. Ulloa, Muñoz, Capmany, Ferreras, Quintana, Navarrete, Clemencin, To-

reno, Lafuente y Alcántara, Gayangos, Muñoz Maldonado, and Modesto Lafuente (as a satirist known under the pseudonyme of Fray Gerundio) have in modern times distinguished themselves as historians. Among the best political writers and orators are Jovellanos, Argüelles, the philosopher Balmes, Miñano, Marina, Larra, Alcalá Galiano, Donoso Cortés, Martinez de la Rosa, Figueras, and Castelar. Novel literature began to be cultivated with great activity when the standard works of England and France became known. Among the best works of the kind are those of Humara y Salamanca, Escosura, Martinez de la Rosa, Larra, Villalta, Serafin Calderon, Gertrudis de Avellaneda, and Cecilia Böhl Faber de Aron ("Fernan Caballero"). Among the brilliant Spanish writers of the present century is the orator Emilio Castelar, who has won a wide reputation. Besides novels, he has published *Discursos parlamentarios*, *Recuerdos de Italia* (translated into English as "Old Rome and New Italy"), and *Vida de Lord Byron* (English translation by Mrs. Arthur Arnold, London and New York, 1875–'6).—There are still many writers in the Catalan dialect, which is considered by the Catalans to be a richer language than the Castilian. Catalan literature produced its best authors in the century preceding the reign of Ferdinand and Isabella. The *Cancionero general*, compiled soon after the middle of the 15th century, is a collection of about 300 poems by 30 different Catalan writers. The works of Ausias March (died 1460), the most noted of these, passed through four editions in the 16th century, and were translated into Latin, Italian, and Castilian, the last by Montemayor. Jaume Roig (died 1478), like March a native of Valencia, is also worthy of notice for his "Book of the Ladies," a satire on woman. In 1428 the *Divina commedia* was translated into Catalan by Andres Febrer; and in 1477 Bonifacio Ferrer made a translation into the same dialect of the Bible (folio, Valencia, 1478), but nearly every copy of it was destroyed by the inquisition. In the beginning of the 16th century Catalan writers began to use the Castilian, and by the middle of that century the latter had almost superseded its rival. The contemporary literature of Catalonia consists mainly of poetry, dramatical pieces, and newspaper articles. The leading writers of the present day are Lo Tamburiner d'el Llobregaz, Victor Balaguir, Francisco Camprodon, Serrafi Pitarra, Jaime Cullell, and Bofarull.—Of the Spanish colonies, Cuba alone has produced some writers of enduring fame, as the poets Heredia and Placido, and the female poet and novelist Gertrudis Avellaneda, before mentioned. In all of the Spanish American republics the different branches of literature, but chiefly poetry, have been and are cultivated with considerable success; but only a few of the writers have more than a local reputation. Among those whose names are known abroad, some of the most eminent are Baralt (1810–'60), author of a *Historia de Venezuela;* the popular Ecuadorian poet Olmedo (born 1784); the Venezuelan Bello (1780–1865), the most distinguished of Spanish American poets and grammarians; J. M. Torres Caicedo, a poet and publicist, author of *Ensayos biográficos*, cited below; Mora, who wrote a history of Mexico; Pedro de Angelis, historian of the Argentine Republic; Eyzaguirre, author of a history of Chili from the discovery to the present century; Marmol, an Argentine novelist, who wrote *Amalia;* Toro of Colombia, Lastarria of Chili, and Sarmiento of the Argentine Republic, the last of whom is the author of *Civilizacion y barbarie*, an analysis of South American society, published in French in 1853, and of the *Vida de Abran Lincoln* (New York, 1865).—The best work on the national literature of Spain is the "History of Spanish Literature," by George Ticknor (3 vols. 8vo, New York and London, 1849), a Spanish translation of which, with additions and notes, by Pascual de Gayangos and Enrique de Vedia, was published in Madrid in 1851–'6. See also Eugenio Ochoa, *Coleccion de los mejores autores españoles* (Paris, 1852); Ferdinald Wolf, *Studien zur Geschichte der spanischen und portugiesischen Nationallitteratur* (Berlin, 1859); Manuel Ovilo y Otero, *Manual de biografía y de bibliografía de los escritores españoles del siglo XIX.* (Paris, 1859); Amador de los Rios, *Historia crítica de la literatura española* (Madrid, 1862); Eugène Baret, *Histoire de la littérature espagnole depuis ses origines les plus reculées jusqu'à nos jours* (Paris, 1863); J. M. Torres Caicedo, *Ensayos biográficos y de literatura sobre los principales poetas y literatos latino-americanos* (3 vols. 8vo, Paris, 1863–'8); and J. M. Rojas, *Biblioteca de escritores venezolanos contemporáneos* (Paris, 1875). Among older works, the German of Bouterwek and the French of Sismondi are valuable; they have been translated both into Spanish and English, and the former into French.

**SPAIN, Wines of.** The Spanish peninsula yields to no other part of Europe in natural advantages for wine growing. With a fertile soil, an admirable geological conformation, and a climate which, aided by the proximity of great bodies of water, tends to develop the vine to a high degree of perfection, it ought to produce natural wines of the choicest quality in respect to body and bouquet; but, in consequence of primitive and faulty systems of vinification, these results are seldom attained, and the Spaniards may be said to excel chiefly in the preparation of white, dry, fortified wines, and a few sweet varieties. The culture of the vine in Spain is almost universal, but in the absence of recent trustworthy statistics the annual yield cannot be readily determined. It has been estimated as high as 660,000,000 gallons, and as low as 300,000,000; the latter amount is doubtless more nearly correct. The principal wines of export and those

most intimately associated with Spanish viticulture are the several varieties of sherry, so called from the town of Jerez de la Frontera, in Andalusia, around which lie perhaps the choicest vineyards of Spain. They form part of the wine district of Cadiz, which also includes San Lucar de Barrameda, on the banks of the estuary of the Guadalquivir; Trebujena, N. of San Lucar; and Puerto de Santa Maria, S. of Jerez, on the W. bank of the estuary of the Rio Guadalete, which forms the eastern frontier of the sherry district. The vineyards of all qualities in the district of Cadiz cover about 24,000 acres, and yield not less than 6,000,000 gallons annually, which is very little in excess of the yearly consumption of so-called sherry in England alone. Between natural sherries and the sherries of commerce, which find their principal market in Great Britain and the United States, there is an important difference. The former are generally light-colored and dry, and after the primary fermentation is complete contain an average of 26 per cent. of proof spirit naturally generated. Under this class may be mentioned the so-called *vinos de pasto*. or table wines, which are light, dry, spirituous, and highly flavored. The wines exported under that name exhibit these qualities in a marked degree, although more or less brandied to suit the English and American taste. But the greater part of the sherries leaving Cadiz have previously been subjected to a treatment which renders them as much a factitious product as champagne. The manufacturers generally buy much more must or wine from other growers than they produce themselves. The juice is deposited in butts of 108 gallons each, and after the first fermentation is racked from the lees, each butt receiving from two to ten gallons of spirit, according to the quality of the wine, the inferior sorts requiring most reënforcement. The wine is subsequently flavored with a liqueur called *dulce*, made from the must of over-ripe grapes, the fermentation of which has been checked by the addition of over-proof spirit; and colored by an admixture of *vino de color*, which is simply must boiled until it is reduced to one fifth of its bulk, and has acquired the consistency of treacle. It is deep reddish brown, and has a harsh and bitter flavor. By means of this agent all the popular shades of color are given to the conventional sherries of commerce. Thus pale sherry requires but 7 gallons to the butt, the golden 15, the pale brown 20, and the rich old brown as much as 25 gallons. The choicest wines of the Cadiz district are not customarily sold or drunk, but are reserved for admixture with poorer sorts, whereby the latter, in addition to the flavoring and coloring processes they have undergone, acquire a premature character of age and ripeness. Hence the custom prevalent among manufacturers of sherry, of keeping up the so-called *soleras*, or stock wines. A solera wine is described as "a fine old mother wine, which by care and attention has acquired body and character. Such wines are kept in stock in butts or double butts, and are perpetuated in the following manner: Of say 20 butts of existing ready solera wine the proprietor draws off one half for mixing with the wine about to be exported. He then fills up the voids created in his 20 butts by means of 10 butts of the finest wine of a later vintage which he can obtain. In old established houses solera wine is therefore a mixture of a great number of wines, of which the latest addition forms one half, the last but one a quarter, and the last but two an eighth of the whole bulk, and so forth, in a ratio which terminates only with the first solera produced without any mother wine. The production of this solera wine is a kind of chemical infection whereby good wine is induced to undergo quickly a process of etherification. This process becomes so potent in some soleras that they are absolutely nasty and undrinkable, like most essences, but command prices of from £800 to £1,000 a butt, on account of the large quantity of flavorless wine which a certain small amount of them will infect with the desired sherry flavor." (Thudicum and Dupré's "Treatise on Wines.") Repeated brandyings of the poorer wines take place previous to shipment, until the 26 per cent. of proof spirit contained in the newly fermented natural wine has been increased to an average of about 37 per cent. Some specimens tested by the London custom house officers have exhibited as much as 50 per cent. The finer sherries are free from this extreme alcoholic character. Those from the neighborhood of Jerez often develop a peculiar etherous flavor called the *amontillado*, which is supposed to arise from the presence of aldehyde, and is very noticeable in some white Greek wines. Around San Lucar are produced the well known *manzanillas*, which derive their name from a certain similarity both in flavor and fragrance to the manzanilla or camomile flower. In their highest perfection they are thin and almost colorless, with a bitter aromatic taste. They are said to be the purest wines of their class, from the fact that they will not mingle readily with other growths. The fine wines of Montilla, long famous throughout Spain, are reputed to develop the amontillado flavor in a remarkable degree, but require several years to reach their best condition. Elsewhere in Andalusia are produced wines assimilating in flavor and in general character to those of Jerez, but greatly inferior in quality. The district of Condado de Niebla, between the coast and Seville, yields a wine so perishable that it has to be largely reënforced with alcohol, after which it is taken to Cadiz and made into sherry for shipment to England.—Malaga has long been famous for the production of wines, both sweet and dry, and raisins. The entire country between the port of Malaga and Granada may be said to form one great vineyard, the

mountainous parts of which near Malaga, owing to exceptional climatic advantages, produce not less than three crops of grapes annually. The first is used exclusively for raisins, while the second yields dry wines and the third sweet wines. The most noted of the latter are rich and of a dark amber color, imparted by the addition of boiled must intentionally burned in the boiling. They are said to keep for more than a century, with the aid doubtless of added spirit, but with age lose much of their sweetness. Toledo and La Mancha produce some excellent red wines, those of the latter district being distinguished by ample body and a peculiar subbitter flavor. The muscat of Juencaral near Madrid is one of the brightest colored and most agreeable wines of Spain. Murcia, Valencia, and Catalonia, which border on the Mediterranean, produce immense quantities of deep-colored, full-bodied wines. Those of Murcia are coarse, rough, and inferior, while those of certain districts of Valencia, notably Alicante and Benicarlo, have considerable reputation. The lower grades of Valencia wines are perishable unless reënforced with alcohol, and are largely employed in making imitation port or in mixing with genuine port wine. Many thousands of butts of spirits are also distilled from them. The Alicante wines, produced from the grape of that name, are sweet, strong, luscious, and often of an almost sirupy consistence. Like other wines of their class, they have to be brandied in order to keep any length of time. Those of Benicarlo are sweet and heady, and are in considerable demand for mixing with the red wines of southern France. The Catalan wines are numerous and of many varieties of flavor, the greater part being cheap and of medium quality. The red kinds predominate, and it is asserted that those of the deepest tint, called in England "Spanish reds," derive their color from a liberal admixture of elderberry juice. They require brandying, and are extensively used for building up the poorer growths of Bordeaux. Much of the cheap claret used in England and America is largely impregnated with Spanish Mediterranean wines. In Aragon, Valladolid, Biscay, Navarre, Asturias, and elsewhere are produced red and white wines of fair quality, but mostly of local reputation. Of late years attempts have been made to naturalize the choice wines of Médoc and Burgundy in northern Spain, in the hope of obtaining wine equal to the products of those districts; but the results have, as a rule, been far from satisfactory. The Balearic islands yield considerable quantities of wine, chiefly muscats and malmseys; while the Canaries, where was made the famous *vino secco* or sack of Shakespeare's time, have almost ceased to be a wine-growing country.

**SPALATO,** or **Spalatro** (anc. *Spalatum* or *Spolatum*), a town of Dalmatia, Austria, on a bay of the Adriatic formed by islands, 74 m. S. E. of Zara; pop. in 1870, 15,784. It has been ately much improved and provided with piers and quays. The archbishop of Spalato is primate of Dalmatia and Croatia. It contains a cathedral (anciently a temple of Jupiter) and other churches, an episcopal palace and seminary, a nautical and other schools, and a museum for Roman antiquities, which abound here. The harbor is spacious, and the trade is especially active with Turkey. Spalato belonged for several centuries to Venice, during the Napoleonic era to France, and since 1815 to Austria.—Three miles E. N. E. of Spalato is the village of Salona, which preserves the name of the ancient capital of Dalmatia. Ancient Salona was an extensive city, and a bulwark of the Romans against the Goths and other barbarians. Some of its buildings and many ruins remain. The emperor Diocletian, who was born near it, resided there during his retirement. A portion of Spalato is on the site of his immense palace, built in 303, and occupying about eight acres, in which the people of Salona took refuge on the destruction of their city by the barbarians; and the name Spalatum is a corruption of *Salonæ Palatium.*

**SPALDING,** a W. county of Georgia, bounded W. by Flint river; area, about 190 sq. m.; pop. in 1870, 10,205, of whom 4,878 were colored. The surface is slightly undulating and the soil fertile. It is traversed by the Macon and Western and the Savannah, Griffin, and North Alabama railroads. The chief productions in 1870 were 18,634 bushels of wheat, 125,984 of Indian corn, 17,164 of oats, and 3,630 bales of cotton. There were 460 horses, 728 mules and asses, 1,169 milch cows, 1,554 other cattle, 1,521 sheep, and 4,256 swine. Capital, Griffin.

**SPALDING, Lyman,** an American physician, born in Cornish, N. H., June 5, 1775, died in Portsmouth, N. H., Oct. 31, 1821. He graduated at Harvard college in 1797, assisted Prof. Nathan Smith in establishing the medical school at Dartmouth college, delivered the first course of lectures on chemistry in that institution, and published "A New Nomenclature of Chemistry, proposed by Messrs. De Morveau, Lavoisier, Berthollet, and Fourcroy, with Additions and Improvements" (1799). He entered upon the practice of medicine at Portsmouth in 1799. In 1812 he was elected president and professor of anatomy and surgery in the college of physicians and surgeons at Fairfield, Herkimer co., N. Y., and in 1813 he removed to the city of New York. He originated the plan for the formation of the "Pharmacopœia of the United States," the first edition of which was published in 1820, under the supervision of delegates from all the medical schools and societies. Dr. Spalding published "Reflections on Fever, and particularly on the Inflammatory Character of Fever" (1817); "Reflections on Yellow Fever Periods" (1819); and "A History of the Introduction and Use of Scutellaria Lateriflora as a Remedy for preventing and curing Hydrophobia" (1819).

**SPALDING, Martin John,** an American prelate, born in Marion co., Ky., May 23, 1810, died in Baltimore, Feb. 7, 1872. He graduated at St. Mary's college, Lebanon, in 1826, studied theology, and went to Rome in 1830 to complete his course at the college of the propaganda. He was ordained priest on Aug. 13, 1834, returned to Kentucky, and was appointed pastor of the cathedral of Bardstown. In February, 1835, he founded the "Catholic Advocate," with which he was connected till 1858. He also founded the "Louisville Guardian" in 1854. In 1838 he was elected president of St. Joseph's theological seminary, Bardstown; in 1840 became pastor of St. Peter's church, Lexington, and in 1841 again pastor of the cathedral at Bardstown. He was invited to deliver a series of discourses on the Roman Catholic church in the cathedral of Nashville in 1843; and he afterward lectured in the chief cities of the United States and Canada. His yearly lectures from 1844 to 1847 were published with the title of "Evidences of Catholicity" (1847; 4th ed., Baltimore, 1866). He was appointed coadjutor bishop of Louisville, Aug. 10, 1848, with the title of bishop of Lengone *in partibus infidelium*, and was consecrated on Sept. 10. He established a colony of Trappist monks at Gethsemane near Bardstown, and a house of Magdalens in connection with the convent of the Good Shepherd. In 1850 he became bishop of Louisville as successor of Dr. Flaget, whose life he wrote (Louisville, 1852), and built a magnificent cathedral. In May, 1852, he was present at the first plenary council of Baltimore, obtained the erection of the new see of Covington, and urged the establishment of a system of parochial schools in every diocese. He went to Europe in November, 1852, obtained in Belgium Xaverian brothers for the parochial schools of Louisville, and from Archbishop Zurysen of Utrecht several priests and a colony of sisters to instruct the deaf and dumb. Having taken steps for the foundation of an American college at Louvain, he returned to the United States in April, 1853, and was involved in a controversy with George D. Prentice of the Louisville "Journal" at the beginning of the Know-Nothing movement in 1855. He published his "Miscellania" during this agitation. In the three provincial councils of Cincinnati, in 1855, 1858, and 1861, Bishop Spalding bore a leading part, and drew up the collective address of the bishops at their close. Another controversy with George D. Prentice grew out of a review by Bishop Spalding of Joseph Kay's work on common school education in Europe, the bishop advocating a denominational system of common schools, such as exists in most European states. In his own diocese he introduced a system of church government calculated to secure the rights of the inferior clergy, and preserve them from arbitrary rule. In 1860 he published "A History of the Protestant Reformation in Germany and Switzerland" (2 vols. 8vo, Louisville; 4th ed., Baltimore, 1866), enlarged from a review of D'Aubigné first published in 1844, and delivered a course of lectures at the Smithsonian institution on the history and elements of modern civilization. He succeeded Dr. Kenrick as archbishop of Baltimore, May 12, 1864, and took possession of his see on July 31. One of his first cares was to found an industrial school for boys intrusted to the Xaverian brothers, which was opened Sept. 8, 1866. As apostolic delegate, he convened the second national council of Baltimore, Oct. 7, 1866, and had the principal part in preparing the measures submitted to its deliberations, and in drawing up the acts of the council in so complete a form as to make the work a standard manual of American canon law (*Concilii Plenarii Baltimorensis II. Acta et Decreta*, Baltimore, 1868). To him is mainly due the foundation of the "Catholic Publication Society" of New York, and of the monthly periodical called the "Catholic World." He took a conspicuous part in the council of the Vatican (1869-'70). Together with other bishops of the United States, he wished for an immediate and final doctrinal judgment on the question of pontifical infallibility, but preferred an indirect and implied definition, consisting in the formal condemnation of every sentiment opposed to the inerrancy of the supreme teaching office of the pope. On Archbishop Spalding's arrival in Rome a *postulatum* in this sense was drawn up by him and signed by the American bishops. Subsequently some of the leading reasons on which the *postulatum* was grounded were publicly quoted by Bishop Dupanloup as arguments against the opportuneness of a doctrinal definition. Passages from the late Archbishop Kenrick's theology were also alleged in support of the opposition. This was resisted by Archbishop Spalding in a letter to Bishop Dupanloup (April 4, 1870), in which he vindicated the orthodoxy of his predecessor, and explained the opinions of the American bishops. At the opening of the council he had been appointed a member of the commission of 16 on *postulata*, and the decided stand taken by the majority of the council in favor of an immediate and formal definition finally induced him and his co-signers to make no further opposition. Archbishop Spalding edited with an introduction and notes Abbé Darras's "General History of the Catholic Church" (4 vols., New York, 1866).

**SPALDING, Solomon.** See MORMONS, vol. xi., p. 833.

**SPALLANZANI, Lazaro,** an Italian naturalist, born at Scandiano, in the duchy of Modena, Jan. 12, 1729, died Feb. 12, 1799. He studied at Reggio and Bologna, and was chosen in 1754 to fill the chair of logic, metaphysics, and Greek in the university of Reggio. In 1761 he accepted a professorship at Modena, and began to obtain a wide reputation by his researches in natural science. In 1767 he produced a work

on the phenomena of generation, showing the preëxistence of germs to fecundation; in 1768 he published the result of his investigations on the production and circulation of the blood; and in 1769 translated Bonnet's *Contemplations de la nature.* In 1775 he contested, in opposition to Needham, the spontaneous generation of the infusoria, and maintained by a long series of ingenious experiments the production of these animalcules from atmospheric germs. In 1770 he was appointed professor of natural history in the university of Pavia. In order to add to the museum of Pavia, he travelled at different times through the principal countries of Europe, resided 11 months in Constantinople about 1785, and on his return lectured to more than 500 students. In later publications he announced remarkable discoveries and theories concerning volcanoes, discussed curious problems in regard to swallows, and suspected the existence of a sixth sense in bats, by which they are guided with precision though deprived of sight. His works are numerous, and many of them have been translated into the principal European languages.

**SPANDAU,** a town of Prussia, in the province of Brandenburg, at the junction of the Spree and the Havel, 7 m. W. of Berlin; pop. in 1871, 19,013. It is a fortress of the third class, and the treasury of the German empire is deposited in the citadel, and can be unlocked only by two keys simultaneously, one of which is in the custody of the chancellor and the other in that of the president of the committee for the debts of the empire. Spandau has a large central prison, new barracks and military hospital, an artillery school for infantry, a royal foundery of artillery, and various manufactories. It is one of the oldest towns of the Mittelmark, and was repeatedly the residence of the electors of Brandenburg. It was occupied by the Swedes from 1631 to 1635, surrendered to the French Oct. 25, 1806, and recovered by the Prussians April 26, 1813.

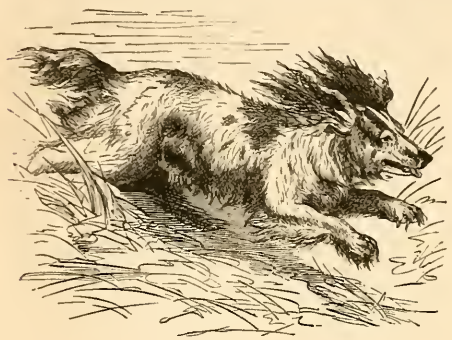
**SPANGENBERG, August Gottlieb,** first bishop of the Moravian church in America, born at Klettenberg, Prussia, July 15, 1704, died at Berthelsdorf, Saxony, Sept. 18, 1792. He graduated at Jena in 1726, began to lecture as a junior professor, and in conjunction with a number of students established free schools in the suburbs of Jena for the children of the poor. In 1731 he was appointed adjunct professor at Halle, and assistant superintendent of Francke's orphan house. His liberal views in respect to such as were not in connection with the established church, and especially his strong love for the Moravians, led to his dismissal from his offices in 1733. He went to Herrnhut, and was appointed assistant to Count Zinzendorf, in which capacity he visited various parts of the continent. Toward the close of 1734 he went to England, where he entered into successful negotiations with the trustees for Georgia relative to a Moravian settlement in that colony. Fifty acres of land were granted him, and 500 acres were made over to Count Zinzendorf. One of these tracts formed a part of the present site of Savannah, and the other lay on the Ogeechee river. Spangenberg arrived at the former tract with nine immigrants in the spring of 1735, and immediately commenced a settlement, which was the first formed by the Moravians in America. Having spent four years partly in Georgia and partly in Pennsylvania, where he preached among his German countrymen, he returned to Europe. His report upon the state of religion in Pennsylvania induced the church to begin an enterprise in that province, and the town of Bethlehem was founded. In 1741 he visited London, where he was made general deacon of the brotherhood, and founded the first organized Moravian society in England. In 1744 he returned to Germany, and, after being consecrated a bishop, went again to America, in order to superintend the entire work of the Moravians in this country, in which he continued for 18 years, interrupted by occasional visits to Europe. He undertook frequent journeys to the Indian country, and was adopted into the Oneida nation. Soon after the conquest of Canada, Spangenberg was appointed a member of the college of bishops and elders elected, subsequently to Count Zinzendorf's death, to govern the three provinces and the missions of the Moravian church. He left America in June, 1762, arrived at Herrnhut in November, and immediately entered upon the duties of his new office, and for 30 years was the leading spirit among his colleagues. In 1764 he was appointed supreme inspector in upper Alsace, and in 1789 president of the general directory. Among his principal works are his *Leben Zinzendorf's* (3 vols., 1772–'5), and *Idea Fidei Fratrum* (1779). The latter is the standard of theology among the Moravians. It was translated into English by Latrobe in 1784, under the title of "An Exposition of Christian Doctrine as taught in the Protestant Church of the United Brethren."

**SPANGENBERG, Friedrich,** a German painter, born in Göttingen in 1843, died while ascending Mt. Vesuvius, June 8, 1874. He studied in Munich, and became known by his picture of Genseric, king of the Vandals, leading the empress Eudoxia and her children into captivity after the sack of Rome. In conjunction with the Belgian painter Pauwel he executed at Weimar "The Triumph of the Union," commemorating the close of the civil war in the United States. While in Rome he painted "A Young Ostrogoth entering into friendly Relations with Citizens of Rome."

**SPANHEIM, Ezechiel,** a Swiss author, born in Geneva, Dec. 7, 1629, died in London, Nov. 7, 1710. He studied at Leyden, was a professor at Geneva, represented the elector palatine in various countries, and subsequently the elector of Brandenburg for many years in Paris, and in the last eight years of his life was Prussian ambassador in London. His works include

*Dissertationes de Præstantia et Usu Numismatum Antiquorum* (4to, Rome, 1664; best ed., 2 vols., London and Amsterdam, 1706–'17), and *Orbis Romanus* (London, 1704; contained also in Grævius's *Thesaurus*, vol. xi.).

**SPANIEL** (*canis extrarius*, Linn.), a well known variety of hunting dog, in form a small setter, with silky hair, long in some parts of the body, and long, soft, pendulous ears. It is figured on some of the later monuments of an-



Spaniel.

cient Italy, and is supposed to be the *C. Tuscus* of the Romans; it probably originated in Spain, whence the name. The colors are various, black, brown, pied, liver-colored and white, and black and white. The English breed is considered the best for sportsmen, being strong, with an excellent nose, and fond of the water. The water spaniel differs from the common breed in the eagerness to hunt and swim in water, whence it is used to drive ducks into the nets in decoy ponds; the hair is also harsher. (See Poodle.) The Alpine or St. Bernard spaniel is the largest and most celebrated of the race, being 2 ft. high at the shoulders, and 5 or 6 ft. from nose to end of tail; it has a peculiar appearance about the inner angle of the eyes, due probably to their being kept partly shut to avoid the high winds and the glare of the snow; this is one of the breeds which search the mountain passes in the vicinity of the *hospice* of St. Bernard in quest of bewildered or weary travellers. The Newfoundland dog resembles the Alpine spaniels; it is large and has great strength, and is probably their indigenous American representative, and useful for many purposes of a beast of burden; it is gentle, very intelligent, and affectionate; it is an excellent swimmer, the toes being partly webbed. The springer is a small spaniel of elegant form, small head, and long ears, usually red and white, the latter predominating, with a black nose and palate; the Marlborough breed is considered the best. The King Charles spaniel is a small and beautiful breed, prized as a lady's pet, generally black and white, or black and tan-colored; the hair is soft and silky, the ears pendulous, the forehead elevated, and the eyes intelligent; the variety prized by Charles I. of England was wholly black; this is the *C. brevipilis* (Linn.). It is supposed to be the parent of the cocker, a sprightly little bird dog, usually black, or white with reddish spots, and comparatively shorter in the back than the spaniel. The Maltese dog is perhaps the most ancient of the small spaniel races, being figured on Roman monuments, and mentioned by Strabo as the *C. melitæus;* the muzzle is round, the hair very long and silky, and the color usually white; it is diminutive, and fit only for a lap dog.

**SPANISH FLY.** See Cantharides.

**SPANISH MAIN,** the appellation formerly given to the southern portion of the Caribbean sea, together with the contiguous coast, embracing the route traversed by Spanish treasure ships from Mexico, Central America, and the northern shores of South America.

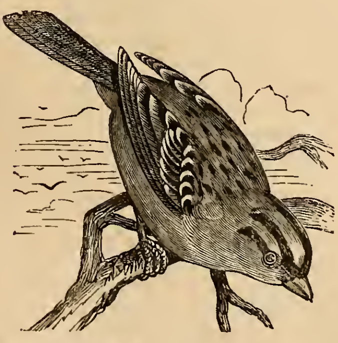
**SPAN WORM.** See Canker Worm, and Caterpillar.

**SPAR.** See Baryta, Calcareous Spar, Feldspar, and Fluor Spar.

**SPARKS, Jared,** an American historian, born at Willington, Conn., May 10, 1789, died in Cambridge, Mass., March 14, 1866. He graduated at Harvard college in 1815, studied theology at Cambridge, and for two years, 1817–'19, was college tutor in mathematics and natural philosophy. He also became one of an association by which the "North American Review" was conducted. In May, 1819, he was ordained as minister of a Unitarian congregation in Baltimore, and the next year published "Letters on the Ministry, Ritual, and Doctrine of the Protestant Episcopal Church" (8vo, Boston). In 1821 he was elected chaplain of the United States house of representatives, and the same year he established "The Unitarian Miscellany and Christian Monitor," which he edited till 1823. In this work he began a series of letters on the "Comparative Moral Tendency of Trinitarian and Unitarian Doctrines" (8vo, 1823). He also edited a "Collection of Essays and Tracts in Theology, from various Authors, with Biographical and Critical Notices" (6 vols. 12mo, 1823–'6). His health becoming impaired, he resigned his pastoral charge in 1823, and removing to Boston purchased the "North American Review," of which he was sole proprietor and editor for seven years. In 1828 he published a "Life of John Ledyard, the American Traveller," chiefly from original materials. After extensive researches in the United States, he made a voyage to Europe in 1828, where he selected and transcribed documents relating to American history in the public offices of London and Paris, and after his return published "The Writings of George Washington, with a Life of the Author, Notes, and Illustrations" (12 vols. 8vo, Boston, 1834–'7). During the preparation of this work he edited and published "The Diplomatic Correspondence of the American Revolution" (12 vols. 8vo, 1829–'30), and "The Life of Gouverneur Morris, with Selections from his Correspon-

dence and Miscellaneous Papers," &c. (3 vols. 8vo, 1832). "The American Almanac and Repository of Useful Knowledge" was founded by Mr. Sparks, who edited the first volume, for 1830. He was also the editor of the "Library of American Biography" (first series, 10 vols. 18mo, 1834–'8; second series, 15 vols., 1844–'8), several of the lives in which were written by him. In 1840 he completed the publication of "The Works of Benjamin Franklin, with Notes and a Life of the Author" (10 vols. 8vo). He then visited Europe a second time, and discovered in the French archives the famous map with the red line drawn upon it, about which so much was afterward said in the debates upon the Ashburton treaty in congress and parliament. In 1852 two pamphlets were printed by him in defence of his mode of editing the writings of Washington, in reply to the strictures of Lord Mahon and others, and a similar pamphlet the next year, occasioned by a reprint of the original letters from Washington to Joseph Reed. In 1854 he published "Correspondence of the American Revolution, being Letters of eminent Men to George Washington, from the time of his taking command of the Army to the end of his Presidency, edited from the Original Manuscripts" (4 vols. 8vo). Mr. Sparks was McLean professor of history at Harvard college from 1839 to 1849, and president of the college from 1849 to 1853. His life, by G. E. Ellis, was published in 1869.

**SPARROW**, the familiar name of many small birds of the finch family, and the old genus *fringilla* (Linn.), which has been numerously subdivided by modern ornithologists; the family characters have been given under FINCH. Among the many American species may be mentioned three distributed under three different genera. The white-crowned sparrow (*zonotrichia leucophrys*, Swains.) is about 7 in. long and 10 in. in alar extent; the body is stout, bill



White-Crowned Sparrow (Zonotrichia leucophrys).

conical, feet robust, the second and third quills longest, and the tail rather long and moderately rounded; the chin, throat, and breast are nearly uniform ashy; the head above black; median and superciliary stripe pure white; a narrow black line through and behind the eyes; back and wing coverts dark reddish brown with paler margins; quills and tail darker; wings with two white bands; whitish below; bill reddish orange tipped with brown; lower lid white. It is found from the Atlantic to the Rocky mountains and from Labrador to Texas, breeding far to the north; the notes are mellow and cheering, six or seven in number, the first loud and clear, and thence becoming fainter and more plaintive; eggs five or six, ⅞ in. long, light sea green with brownish mottlings at the larger end; the nest is on the ground or among moss, and the eggs are laid in Labrador from the 1st to the end of June. The flight is low, but swift and long protracted; the migrations are performed mostly by day; the food consists of seeds, berries, minute shell fish, and insects. The genus *spizella* (Bonap.) differs from the last in its smaller size and longer forked tail. The chipping sparrow (*S. socialis*, Bonap.), commonly called chip bird, is 5½ in. long and 8½ in. in alar extent; the rump, back of neck, and sides of head and neck are ashy; the back has black streaks with pale rufous edgings; the crown is uniform chestnut, the forehead black with a white median line, a white streak over the eyes and a black one from the bill through and behind the eyes; white below, tinged with ashy on the upper breast; tail and primaries with paler edgings, and two narrow white bands across wing coverts; bill black; in the young the crown has narrow blackish lines, and the upper breast and sides are streaked with brown. It inhabits North America from ocean to ocean, very common everywhere, except in woods, in spring, summer, and autumn, going south in winter; it is very social, is found with almost every other species of sparrow, and is so familiar as to enter yards and even piazzas for food. The nest is never made on the ground; the eggs are four or five, ¾ by ⅝ in., greenish blue, with slight brown spots at the larger end, and rather pointed at the smaller. The notes are six or seven rapidly repeated and loud "cheeps;" the flight is short, irregular, and rather low. They are the most numerous of the sparrows in New England, but arrive some weeks later than the song sparrow. The genus *melospiza* (Baird) differs from *zonotrichia* in the shorter and more graduated tail, longer hind toe, shorter and more rounded wings, longer tertiaries, unspotted under parts, and streaked crown. The song sparrow (*M. melodia*, Baird) is 6½ in. long and 8½ in. in alar extent; the general tint above is rufous brown, with dark brown streaks and grayish edgings; crown rufous, with superciliary and median stripe of dull gray; white below, breast and sides streaked with dark rufous; no distinct white on wings or tail. It is found from the eastern coast to the high central plains, and is abundant in the south, where it raises three broods, making a new nest for each. Though not so handsome as some other sparrows, its song is much sweeter, prolonged, and heard at all hours of the

day; it nests both on the ground and in bushes; the eggs are four to six, broad ovate, light greenish white with specks of dark brown; both sexes incubate. The flight is short and much undulated; it goes south in winter, and seldom approaches houses nearer than gardens and orchards; it is very active, feeding on insects, seeds, and berries.—The old world spar-

House Sparrow (Passer domesticus).

rows belong to the genus *passer* (Briss.), in which the wings are moderate, with the second and third quills rather longer than the first, and the moderate tail even or slightly forked. There are about 20 species, residing in cultivated regions, even in the midst of cities; the food consists of buds, seeds, grains, and insects; the nest is in trees or hedges, and the eggs are four or five. The house sparrow (*P. domesticus*, Linn.) is $6\frac{1}{4}$ in. long and $9\frac{1}{2}$ in. in alar extent; in the male the upper part of the head is light brownish gray, the sides of the neck grayish white, throat black, back and wings chestnut and black with a white band across the latter, and lower parts light brownish gray; in the female the head is grayish brown above and the lower parts light brownish gray. They often commit serious depredations in wheat fields; though feeding chiefly on grain, they bring up their young on larvæ, and a pair is said to destroy about 4,000 caterpillars weekly in the breeding season; they are generally distributed over northern and central Europe, and are brighter colored in the country than in the cities; they have no song, except a single note, loud and by no means agreeable. This species has been introduced into the United States, where it thrives well, and does good service in destroying canker worms and other injurious larvæ in and around the large cities and towns; they require feeding and houses during the severe winters. They were first brought to New York about 1862, and there have been several later importations; they drive nearly all other birds from places where they abound.

**SPARROW HAWK,** a small bird of prey of the falcon subfamily, and genus *tinnunculus* (Vieill.), which differs from *falco* (Linn.) in having longer tarsi, covered in front with large transverse hexagonal scales. There are about a dozen species, widely distributed over the globe; their flight is very graceful, irregular, with occasional hoverings; they eat small birds like sparrows, mice and moles, lizards, beetles, and grasshoppers; the nest is made of a few loose sticks on a rock or in a hollow tree, and the eggs are four to six. The American sparrow hawk (*T. sparverius*, Vieill.) is one of the handsomest, most active, and abundant birds in the United States, and is found over the entire continent of America. It is 11 to 12 in. long, with an alar extent of 22 in.; the crown is light red surrounded by blue, the latter color showing itself also on the wings; back light rufous, spotted with black; tail darker, with broad black band near the end, tipped with white, and lateral feathers with broad black bars on the inner webs; quills black, with white spots on inner webs; throat and upper neck on sides white, with two black bands on the latter; three spots on hind neck, and numerous ones on abdomen and sides, black; white below, tinged with yellowish on breast; the young birds have wider bands of black, and the females longitudinal black lines on the crown and stripes on the

American Sparrow Hawk (Tinnunculus sparverius).

tail. The eggs are dark cream or light buff, more or less spotted with brown, nearly spherical, $1\frac{1}{4}$ by $1\frac{1}{8}$ in.; both sexes incubate, two broods being raised in the south; the pairing time is from February to June, according to latitude.—The European sparrow hawk (*T.*

*alaudarius*, Briss.) has been described under KESTREL. The *accipiter nisus* (Pall.) of Europe is also called sparrow hawk; the male is dark bluish gray above, reddish white below with yellowish red transverse bars; the female is grayish brown above, and grayish white below barred with dark gray. The size and habits are about the same in both.

**SPARTA**, or **Lacedæmon**, in antiquity, the capital of Laconia and the chief city of the Peloponnesus. It was on the right bank of the Eurotas, between the tributaries Œnus and Tiasa, about 20 m. from the sea, in a valley of remarkable beauty and fertility, bounded W. and E. by the ranges of Taygetus and Parnon. It was about 6 m. in circumference, and consisted of distinct quarters which were originally separate villages. During its most flourishing period it was unfortified, being protected by the natural ramparts of the valley. Its quarters were Pitane in the north, the favorite place of residence, Cynosura in the southwest, Limnæ in the east along the Eurotas, and Mesoa in the southeast. Ægidæ, in the northwest, adjoining Pitane, is also mentioned by some writers, but it was probably the name of a tribe or family and not of a quarter. One of its steepest hills (the northern hill, according to Leake; the hill of the theatre, according to Curtius) was called the acropolis, on which were the temples of Athena Chalciœcus, the tutelary goddess of the city, of Athena Ergane, the Muses, Zeus Cosmetas, and Aphrodite Areia, and many statues in honor of divinities and heroes. In the agora, near the acropolis, and adorned with temples and statues, were the council house of the senate and the offices of the public magistrates, the Persian *stoa* built of spoils taken in the Persian war, and the place called Chorus where Spartan youths danced in honor of Apollo. Two principal streets, named Aphetaïs and Skias, extended nearly parallel to each other from the agora, the former to the S., the latter to the S. E. extremity of the city. Upon the largest of the Spartan heights was the theatre, a magnificent building of white marble, the two wings of which still remain, 430 ft. apart, built of massive quadrangular blocks, and forming the most important relics of the ancient city. The private houses of Sparta, and even the palace of the kings, were always simple and unadorned, but it was equalled by few other Greek cities in the magnificence of its temples and statues. The modern town of Sparta, built since the war of independence, occupies one of the hills in the S. part of the ancient site. Its streets are laid out on a large scale, and it has a population of about 8,000. The nomarch and other officials of Laconia reside here. The villages of Magula and Psychiko are near it, and 3 m. W. of it is Mistra, which was the chief place of the district in mediæval and Turkish times.—According to tradition, the Leleges were the most ancient inhabitants, and Lelex the first king, in the vale of the middle Eurotas. Lacedæmon, son of Jupiter and Taygete, married Sparta, third in descent from Lelex, and gave the name of his wife to the city which he founded, and his own name to the people and country. During the mythical era of the Achæan monarchies, Menelaus reigned at Sparta, as Agamemnon at Mycenæ and Diomedes at Argos. After the Dorian invasion and conquest of the Peloponnesus, under the Heraclidæ, Sparta fell to Eurysthenes and Procles, the twin sons of the Heraclid Aristodemus; and from that epoch date the long succession of two joint kings, and the distinction between the conquerors, who were called Spartans, and the native Achæans (*Periœci*), who became tributary. At first inferior to Argos, Sparta became the chief of the Dorian powers only after the institutions of Lycurgus had made it a nation of professional soldiers. The introduction of the Lycurgan discipline (not later, according to Grote, than 825 B. C.), the earliest determinable event in its internal history, was followed by aggressions which gradually extended its sway over the greater part of the Peloponnesus. There is no certain personal history of Lycurgus, and his very existence has been doubted by critics. (See A. Trieber, *Forschungen zur spartanischen Verfassungsgeschichte*, Berlin, 1871.) The Lycurgan legislation has been called the codification of the usages of the Doric race. It recognized three classes of persons: 1, the Spartans, of Dorian stock, resident in the city, alone eligible to public offices, all warriors, supported from the lands around the city which belonged to them, and being disfranchised when they failed to pay their quota to the public mess; 2, the Periœci or Laconians, freemen of the neighboring townships, with no political power, devoted to agriculture and industry, paying rent for their land, and forming bodies of heavy-armed soldiers in war; and 3, the helots, or serfs, bound to the soil, which they tilled for the Spartan proprietors, and sometimes employed both in domestic and military service. The equal division of land into 9,000 lots for Spartans and 30,000 lots for Periœci is doubted by Grote; and the number of Spartan citizens diminished from the era of the Persian war, when Herodotus estimated them at 8,000, to the time of Agis IV., when they had dwindled to 700, of whom 100 alone possessed most of the landed property of the state. At the head of the government were two hereditary kings, whose power was gradually restricted till their position was one of nominal honor rather than real authority. The legislative power was exercised by two assemblies, that of the elders and that of the citizens; the former was composed of the two kings and 28 members aged at least 60 years, who were judges in capital cases, and initiated and discussed all measures submitted to the popular assembly; and the latter, composed of all Spartan citizens of 30 years of age and of unblemished character, met once a month, and had the right to ap-

prove or reject measures by acclamation, but not to amend them. The ephors, corresponding to the Roman tribunes of the people, and probably of later origin than the age of Lycurgus, were the representatives of this assembly, and during the Peloponnesian war exerted despotic authority, having completely superseded the kings as directors of affairs. The most important part of the Lycurgan legislation related to the discipline and education of the citizens. The individual was held to exist exclusively for the state, to which he should devote all his time, property, and energies; and every child, therefore, was under public inspection from his birth, and was trained simply with reference to warlike exercises, since mechanical labor, husbandry, and commerce were despised and neglected. If weak or deformed, he was exposed to perish; otherwise, he was taken at seven years of age from his mother's care, and educated in the public classes, where he was subjected to the severest bodily discipline, to habits of subordination, dexterity, and a terseness of speech which became distinguished as "laconic." At the age of 30 he was allowed to engage in public affairs and to marry, but still continued under public discipline, took his meals at the public mess, slept in the public barracks, and was released from military service only in his 60th year. Both sexes were subjected to nearly the same rigorous gymnastic training, the aim being not domestic enjoyment or refinement, but the production of a hardy race of citizens. The great men that arose from this discipline were distinguished exclusively for military genius.—Under the Lycurgan constitution Sparta began its career of conquest. The first and second Messenian wars (743–723 and 685–668, according to the common chronology) doubled its population and territory. Before 600 B. C. it had conquered from the Arcadians the upper parts of the valley of the Eurotas, and after repeated contests compelled Tegea, the capital of Arcadia, to acknowledge its supremacy (about 560). The long struggle between the Spartans and Argives terminated in favor of the former by decisive victories in 547 and 524. Sparta had now acquired the hegemony of Greece, and Crœsus when threatened by the Persians had formed an alliance with it as the most powerful Greek state. It twice invaded Attica, and interfered in the affairs of the growing Athenian democracy. At the outbreak of the second Persian war, it was by unanimous consent intrusted with the chief command. The battles of Thermopylæ and Salamis in 480, and of Platæa in 479, were fought respectively under the Spartan generals Leonidas, Eurybiades, and Pausanias. According to Herodotus, the Lacedæmonians were represented at Platæa by 5,000 citizens, 5,000 Periœci, and 35,000 helots. The allies, excepting Ægina and the Peloponnesian states, were alienated by the arrogance of Pausanias, and therefore in 476 offered the supremacy to Athens. The hegemony thus passed from Sparta to Athens, and the rivalry of these states modified all the history of Greece till the Macedonian era. A destructive earthquake occasioned a revolt of the helots and the third Messenian war (464–455). The Spartans distrusted and rejected an auxiliary force sent by the Athenians under Cimon, which was the cause of hostilities (457–452), the prelude to the long Peloponnesian war (431–404). This war, in which the opposed Doric and Ionic races exhausted their energies, terminated with the conquest of Athens and with the restoration of the hegemony to Sparta. One of its allies was Cyrus the Younger, and in return it aided him in his attempt to dethrone his brother Artaxerxes. The successes of Agesilaus in Asia Minor in 396 had led him to form the project of overthrowing the Persian empire, when he was recalled by a confederacy of Corinth, Argos, Thebes, and Athens, which Persian gold and Greek jealousy had prompted against Sparta. The victories of Corinth and Coronea were counterbalanced by the naval defeat off Cnidus, and the peace of Antalcidas (387), which left it supreme in Greece, deprived it of its cities in Asia Minor. The Spartans exerted unrivalled authority, notwithstanding the alliance of Thebes and Athens against it in 379, until, in the fatal battle of Leuctra in 371, they were defeated by the Thebans under Epaminondas, and, for the first time in their history, by inferior numbers. Invasion followed, Sparta narrowly escaped capture, its army was again defeated at Mantinea in 362, and it was stripped of the dominions which it had acquired from the Messenians, Arcadians, and Argives; and from this time it ceased to be a leading state in Greece. Having incurred the enmity of Philip of Macedon by supporting the Phocians in the sacred war, its losses were confirmed and its power still further reduced by him; but it refused to join the alliance of Athens and Thebes against him before the battle of Chæronea, next to recognize his leadership in the proposed expedition against Persia, and subsequently to join the Achæan league against the Macedonian and Roman supremacy. It prompted an anti-Macedonian movement, which was defeated by the victory of Antipater at Megalopolis in 331. The kings Agis IV. (244–240) and Cleomenes III. (236–220) attempted to revive the ancient virtue by restoring the institutions of Lycurgus, abolishing the ephoralty, cancelling all debts, redistributing the lands, and enlarging the number of citizens by bringing back the exiles and bestowing the franchise on many of the Periœci and on others who were deserving of it; but the defeat of Sellasia (221) by the Achæans and the Macedonians under Antigonus Doson followed, and Sparta for the first time fell into the hands of conquerors. From intestine factions sprang the usurpations of Machanidas and Nabis (210–192), after which it was compelled with the

whole of the Peloponnesus to submit to the Achæan league, until in 146 it fell with the rest of Greece under the dominion of Rome. (See ATHENS, and GREECE.)

**SPARTACUS**, a Roman gladiator, of Thracian birth, leader of a servile insurrection in 73–71 B. C. Originally a shepherd, he became a chief of banditti, and was captured by the Romans. He was sold and trained as a gladiator, and in 73 persuaded 77 of his associates to escape with him from the school of Lentulus at Capua. They took refuge in the crater of Mt. Vesuvius, and chose Spartacus for their leader. C. Claudius Pulcher was sent against them with 3,000 men, but was defeated, and his arms became the trophy of the victors. Spartacus now proclaimed liberty to all slaves that should flee to him, and for two years he held the supremacy in Campania, Lucania, Bruttium, and other parts of Italy. At the head of 70,000 men he triumphed over two consular armies in 72, and forced his Roman captives to fight as gladiators at the funeral games which he celebrated. His army increased to 100,000 men, the consuls were again defeated, and he meditated an attack upon Rome itself. His own desire was to secure the freedom of the slaves by taking them beyond the Alps, but they, eager for plunder, refused to leave Italy. He for a time maintained his superiority in 71, but in consequence of repeated divisions among his troops, he was twice defeated by Crassus, and fled with his followers. Through the treachery of Cilician pirates, who were to carry him over to Sicily, 12,000 of his men fell into the hands of the Romans. He at length effected his escape, but his followers refusing to go to the north, he faced the Romans again, defeated them, and went to Brundusium, where, baffled in his attempt to seize the shipping, he perished in battle with Crassus near the head of the river Silarus. Pompey completed the work of extinguishing the insurrection. Of the rebels 60,000 fell in combat, and 6,000 prisoners were crucified in the Appian way. Roman writers naturally paint the character of Spartacus in the blackest colors, but critical investigations have led modern historians generally to speak in his praise.

**SPARTANBURG**, a N. W. county of South Carolina, bordering on North Carolina, and watered by affluents of Broad river; area, about 900 sq. m.; pop. in 1870, 25,784, of whom 8,408 were colored. The surface is mostly hilly; the soil is productive. It is traversed by the Spartanburg and Union and the Atlanta and Richmond Air-line railroads. The chief productions in 1870 were 73,783 bushels of wheat, 525,698 of Indian corn, 36,106 of oats, 30,247 of sweet potatoes, 2,851 bales of cotton, 15,345 lbs. of wool, and 170,951 of butter. There were 2,465 horses, 1,794 mules and asses, 5,451 milch cows, 6,740 other cattle, 11,380 sheep, and 19,701 swine; 4 manufactories of carriages and wagons, 5 of cotton, 18 flour mills, 8 tanneries, and 8 currying establishments. Capital, Spartanburg Court House.

**SPAULDING, Levi**, an American missionary, born in Jaffrey, N. H., Aug. 22, 1791, died in Ceylon, June 18, 1873. He graduated at Dartmouth college in 1815, and at Andover theological seminary in 1818, was ordained at Salem, Mass., and reached Jaffna, Ceylon, early in 1820. In addition to the usual missionary labor, much of the time he superintended the female boarding school at Oodooville, and performed a large amount of literary labor, superintending the press, preparing tracts and hymns in the Tamil language, and translating or writing books, among which are "Pilgrim's Progress," "Scripture History," a "Tamil Dictionary," "Notes on the Bible," and a revised edition of the Scriptures in Tamil. He revisited the United States in 1844.

**SPEAKER**, a term applied to the presiding officer of each house of the parliament of Great Britain, of the house of representatives of the United States congress, and generally of the lower houses of the state legislatures. The house of commons elects its own speaker, who must be approved by the crown, and who can only speak or vote in committee, except in the case of an equality of votes, when he gives the casting vote. He holds office until the dissolution of the parliament. The office existed as early as the reign of Henry III., when Peter de Montford communicated the answer of parliament to Pope Alexander IV., but the name was not used till the reign of Edward III. The speaker of the house of lords is the lord chancellor for the time being, appointed by the crown. The house of representatives of the United States elects its own speaker at the first session of each congress, who holds office until the meeting of the next congress; and in the state legislatures an analogous practice prevails.

**SPECIES**, in its most general acceptation, a kind or sort of something, which something is the *genus* to which the species belongs. Thus, a black stone is a species of the genus stone; a gray horse is a species of the genus horse; a scalene triangle is a species of the genus triangle; and, generally, it may be said that every adjective denotes a species of the genus indicated by the substantive to which it is applied. In the technology of the physical sciences the term "species" has a more restricted signification. It is used to denote a group of individuals which corresponds with an early stage of that process of abstraction by which the qualities of individual objects are arranged in the subordinated categories of classification. The individual object alone exists in nature; but, when individual objects are compared, it is found that many agree in all those characters which, for the particular purpose of the classifier, are regarded as important, while they differ only in those which are unimportant; and those which thus agree constitute a species, the definition of which is a statement of the com-

mon characters of the individuals which compose the species. Again, when the species thus established are compared, certain of them are found to agree with one another, and to differ from all the rest in some one or more peculiarities. They thus form a group, which in one sense is merely a species of higher order, while technically it is termed a "genus." And, by a continuation of the same process, genera are grouped into families, families into orders, and so on. Each of the groups thus named is in the logical sense a genus, of which the next lower groups constitute the species. The characters on which species are based necessarily depend upon the nature of the bodies classified. Thus, mineral species are founded upon purely morphological characters; that is to say, they are defined by peculiarities either of form, color, and the like, or of structure; which last term may be used to include both the physical and the chemical characteristics of a mineral. The distinction between a species and a variety is wholly arbitrary, except so far as it is commonly agreed that individuals which differ from others only as terms of a gradual series of modifications belong to the same species, and are to be considered merely as varieties of that species. It is conceivable that animals and plants should have been known to us only by their remains preserved in museums or in the fossil state. If this had been the case, biological like mineralogical species could have been defined only by morphological characters; that is to say, by the peculiarities of their outward form and inward structure; and, as a matter of fact, this is the state of our knowledge in respect of a large proportion of the existing fauna and flora of the world, and of all extinct animals and plants. A botanist or a conchologist, who sets to work to arrange a newly received collection, sorts out his plants or his shells according to their likenesses and unlikenesses of form and structure, until he has arranged them into groups of individuals which agree in certain constant characters, and differ only by insignificant features, or by such peculiarities as vary in different individuals in such a manner that an insensible gradation can be traced between those forms which have the peculiarity strongly marked and those in which it is absent. Thus far the considerations which guide the biologist in the establishment of species differ in no respect from those which influence the mineralogist. But although naturalists have no more direct knowledge of any but the morphological characters of the great majority of the species of animals and plants than they would have of so many mineral specimens, they are familiar with many animals and plants in the living state, when they exhibit phenomena to which the mineral world presents no parallel; and the study of these phenomena of active life has complicated the conception of species in biology, by adding physiological to morphological considerations. The fact that living beings originate by generation from other living beings is one of the circumstances in their history which most completely differentiate them from minerals; and ideas derived from the study of the phenomena of generation enter in various ways into the conception of biological species. For example, it is a generally assumed axiom in biology that whatever proceeds from a living being by way of generation is of the same species as that from which it proceeds, whether the morphological differences between parent and offspring be great or small. The two sexes are often extraordinarily different, and in cases of the so-called "alternation of generations" the successive zoöids may differ very widely; but, inasmuch as the differing forms in these cases proceed from one parentage, no one doubts that they belong to the same species. The breeds of domesticated animals and plants often differ morphologically as widely as admitted species do; but, apart from other considerations, historical evidence that they have the same parentage suffices to cause them to be regarded as of one species. It is not quite clear that the converse of the axiom which has just been referred to would now be admitted, and that living beings which arise from totally distinct parents must be held to be of different species, even though morphologically identical. The well-nigh exploded hypothesis of the multiplicity of centres of origin for species of wide distribution, indeed, implies the belief that groups of individuals which have proceeded from distinctly created parents may nevertheless be of the same species; while the supporters of the no less nearly extinct hypothesis of the independent creation of the faunas and floras of successive formations used to affirm that, although indistinguishable, two animals or plants from separate formations must be of distinct species, because they have been created separately. However, these subtleties have ceased to have any practical importance. In the next place, it is observed that, while individuals of the same morphological species breed freely with one another and give rise to perfectly fertile offspring, the unions of individuals of different morphological species are, as a rule, either infertile or imperfectly fertile. Thus fertility, like parentage, has become a physiological character of species; and though in the case of some domesticated animals, as pigeons, the extreme forms are more different from one another than are many morphological species, yet, apart from the historical evidence of their parentage, they are held to be members of the same species because they are all perfectly fertile one with another, and their offspring are also perfectly fertile. Thirdly, it is a matter of experience that, as a general rule, and taking the whole cycle of forms through which a living being runs into account, offspring and parent are so similar that they belong to one and the same morphological species; and it is further in evidence that many species have endured for extremely long periods

without any notable difference being discernible between ancestor and descendant. Moreover, in some cases, varieties are found to revert to the characters of the species from which they have proceeded. The conclusion has been drawn that species are physiologically fixed; that is to say, that, however long the process of generation may be continued, the individuals either retain the identical morphological peculiarities of the oldest ancestor, or, if they vary, the varieties remain fertile with one another. Assuming that species have the physiological fixity thus indicated, certain conclusions respecting the origin of species are inevitable. It is clear that no existing species can have arisen by the intercrossing of preëxisting species, or by the variation of preëxisting species; but that every species must either have existed from all eternity, or have come into existence suddenly in its present form, which is the objective fact denoted by what is termed "creation."—At the dawn of modern biology, a century ago, no scientific evidence respecting the real history of life on the globe was extant, and, for any proof that existed to the contrary, species might have been of eternal duration. But philosophical speculation combined with theological dogma not only to favor the contrary opinion, but to lead the most philosophic naturalist of his day to embody the hypothesis of creation in a definition of species. *Totidem numeramus species quot in principio formæ sunt creatæ* ("We reckon as many species as there were forms created in the beginning"), is the well known formula of Linnæus. In practice, Linnæus regarded species from a purely morphological point of view; in theory, he assumed the ancestral creation and the limited variability of species, though he was disposed to allow more freedom in this direction than most of his successors. On the other hand, he seems to have attached comparatively little weight to the assumed sterility of hybrids, and to have held a sort of modified doctrine of evolution, supposing that existing species may have been produced by the interbreeding of comparatively few primordial forms. It is mainly to the influence of Cuvier's authority that we owe the general acceptance of the views respecting the physiological characters of species which till within the last few years have been almost universally prevalent. In the introduction to the *Règne animal* (1817), Cuvier writes: "There is no proof that all the differences which now distinguish organized beings are such as may have been produced by circumstances. All that has been advanced upon this subject is hypothetical; experience seems to show, on the contrary, that in the actual state of things varieties are confined within rather narrow limits, and, so far as we can retrace antiquity, we perceive that these limits were the same as at present. We are thus obliged to admit of certain forms which since the origin of things have been perpetuated, without exceeding these limits; and all the beings appertaining to one of these forms constitute what is termed a *species*. Varieties are accidental subdivisions of species. Generation being the only means of ascertaining the limits to which varieties may extend, species should be defined, the reunion of individuals descended from one another, or from common parents, or from such as resemble them as closely as they resemble each other; but, although this definition is rigorous, it will be seen that its application to particular individuals may be very different when the necessary experiments have been made." It need hardly be said, however, that in practice Cuvier founded his species upon purely and exclusively morphological characters, just as his predecessors and successors have done. The combination of Cuvier's views on the fixity of species with the discovery of the succession of life on the globe, which was so largely the result of his labors, led his followers into curious difficulties. Developing the fundamental idea of the *Discours sur les révolutions de la surface du globe*, naturalists were necessarily led to conclude, not only that existing species are the result of creation, but that the creative act which brought them into being was only the last repetition of a series of such acts, by which the often depopulated world has been as frequently repeopled. Lamarck, Cuvier's contemporary and countryman, must be regarded as the chief founder of the reaction against the doctrines which Cuvier advocated; a reaction which, overpowered and disregarded for many years, has acquired such force since and through the publication of Darwin's "Origin of Species," that it has already almost swept opposition away. Lamarck's vast acquaintance with the details of invertebrate zoölogy rendered him familiar with the great variability of many species, and led him to see that variation is in some way related to change of conditions. The frequent occurrence of transitional forms between apparently distinct species, when large suites of specimens (especially when they are obtained from different parts of a wide geographical area) are examined, tended to bring into strong light the tenuity of the distinction between species and varieties. The facts of embryology, the occurrence of rudimentary organs, and the fundamental unity of structure which obtains in vast groups, such as the vertebrata and arthropoda, further tended to suggest the existence of a genetic connection between the members of these groups; so that Lamarck was induced to renounce the doctrine of the fixity of species, and to define a species as "a collection of individuals which resemble each other and produce their like by generation, so long as the surrounding conditions do not alter to such an extent as to cause their habits, characters, and forms to vary." According to this definition, the distinction between species and variety once more becomes conventional. A variety is, in fact, a nascent species; and

the notion of the creation of species vanishes, inasmuch as every species is the result of the modification of a predecessor. Lamarck's views of the nature of geological change were in harmony with his biological speculations, and wholesale catastrophic revolutions were as completely excluded from the one as from the other. It is impossible to read the *Discours sur les révolutions* of Cuvier and the *Principes* of Lamarck without being struck with the superiority of the former in sobriety of thought, precision of statement, and coolness of judgment. But it is no less impossible to consider the present state of biological science without being impressed by the circumstance that it is the conception of Lamarck which has triumphed, and that of Cuvier which has been vanquished. Catastrophic geology has vanished, and is everywhere replaced by the conception of slow and gradual change. With it has disappeared the once prevalent notion that the whole living population of the earth has been swept away and replaced in successive epochs. On the contrary, it is now certain that the changes which have taken place in that population have been effected by the slow and gradual substitution of species for species. Moreover, it is well established that, in some cases, the succession of forms in time is just such as that which should have occurred if the hypothesis of evolution is well founded. The rapid advance of comparative anatomy has diminished or removed the wide intervals which formerly appeared to separate the different divisions of the animal and vegetable kingdoms from one another. Even the hiatus between the vertebrata and the invertebrata is bridged over by recent discovery. The establishment of the cell theory, however much the views originally propounded by Schwann have been modified, leaves no doubt that there is a fundamental similarity in minute structure not only between all animals, but between them and plants; while the discoveries of embryologists have proved that even the most complex forms of living beings do, in the course of their development, run through a series of changes of the same order as those which are postulated by the evolution theory for life in time. Again, the facts of geographical distribution, as now known, are absolutely incompatible with the hypothesis that existing animals and plants have migrated from a common centre, and, by demonstrating the similarity of the existing fauna and flora of any locality to those which inhabited the same area in the immediately precedent epoch, have furnished a strong argument in favor of the modifiability of species. Thus, it is not too much to say that the facts of biology known at the present day are all consistent with and in favor of the view of species entertained by Lamarck, while they are unfavorable to, if not incompatible with, that advocated by Cuvier; and that, even if no suggestion had been offered, or could be offered, as to the causes which have led to the gradual evolution of species, the hypothesis that they have arisen by such a process of evolution would be the only one which would have any scientific foundation.—The great service which has been rendered to science by Mr. Darwin, in the "Origin of Species," is that, in the first place, he has marshalled the ascertained facts of biology in such a manner as to render this conclusion irresistible; and secondly, that he has proved the following proposition: Given the existence of living matter endowed with variability, the interaction of variation with the conditions of existence must tend to give rise to a differentiation of that living matter into forms having such morphological relations as are exhibited by the varieties and species which actually exist in nature. What is needed for the completion of the theory of the origin of species is, first, definite proof that selective breeding is competent to convert permanent races into physiologically distinct species; and secondly, the elucidation of the nature of variability. It is conceivable that both the tendency to vary and the directions in which that tendency takes effect are determined by the molecular constitution of a living body; in which case, the operation of changes of external conditions will be indirect, and, so to speak, permissive. It is conceivable, on the other hand, that the tendency to vary is both originated and directed by the influence of external conditions; or that both variation and the direction which variation takes are partly determined by intrinsic and partly by extrinsic conditions. In this case, surrounding circumstances must be regarded as, to a greater or less extent, the true causes of variation.

**SPECIFIC GRAVITY.** See Gravity, Specific.

**SPECTACLES,** contrivances worn to assist sight or to protect the eyes from injury. 1. *Spectacles to assist Sight.* These may operate in two general ways: first, by correction of some optical defects to which the eyes are liable; and secondly, by compensation for functional insufficiency on the part of certain muscles concerned in the exercise of sight. The eye is a camera, where a system of lenses throws an image upon a screen, represented by the retina. For perfect sharpness of this image, the curves of the lenses must be symmetrical, and the refractive power of the system exactly adjusted to the distance of the retina. In the normal or "emmetropic" eye these conditions obtain, the adjustment being such that when the eye is at rest the rays from distant objects come to an exact focus upon the retina. But every possible deviation from these conditions is found. First, there may be a disproportion between the refractive power of the eye and the distance of the retina. If the refractive power is proportionately too great, the rays from distant objects will come to a focus a certain distance in front of the retina. This constitutes the condition called

*myopia* or near-sightedness, and may arise either from excessive convexity of the lens system of the eye, or from an undue depth of the organ from before backward. The latter origin is by far the more common, and is generally the result of a disease of the tunics of the eye at their back part, whereby being weakened, they bulge out backward. However produced, the correction of myopia is the same. The difficulty being that the refractive power of the eye is too great for the distance of the retina, the obvious remedy is to weaken the former, and this is done by wearing a concave glass. (See Optics.) But there are many physiological reasons why full correction of the defect is often improper or useless, which cannot be discussed here. In any but very moderate degrees of myopia glasses should be worn only under competent advice; and in any case great injury may be produced by the use of too strong glasses. The opposite condition to myopia is also very common, that is, where the refractive power of the eye lenses is disproportionately weak, so that the rays from distant objects come to a focus behind the retina, in which case vision of objects both far and near is indistinct. This constitutes the condition known as *hypermetropia*, and, as in myopia, the deviation from the normal condition may be either in the refractive power or in the depth of the eye. Thus a tolerably common congenital malformation is an undue shallowness of the eyeball. Such an eye is necessarily hypermetropic. A normal eye may also become hypermetropic in old age, and in all cases where the crystalline lens of the eye is wanting, as after removal for cataract (see Cataract, and Eye), a high degree of hypermetropia necessarily results. The fault being that the refractive power of the eye is disproportionately weak to suit the distance off of the retina, the necessary additional power can be supplied by a convex glass worn before the eye. But in the case of the more common congenital hypermetropia from deficient depth of the eyeball, so many other considerations than the mere optical one affect the matter of correcting the defect by glasses, that perfect neutralization is often unadvisable or unnecessary. For the eye has itself the power of increasing the refraction of its lens within a certain range, to provide for the focalizing upon near objects. (See Vision, section on accommodation of the eye.) Hence the organ can itself compensate for a certain amount of hypermetropia, and may thus be able to do without glasses, or with weaker ones than those required to neutralize the defect completely. The third optical error remediable by glasses is a certain want of symmetry in the curve of the cornea, where there are two opposite meridians of unequal curvature. This condition is called astigmatism, and is generally a congenital malformation. The consequence of it is that the retinal image, whether of far or near objects, is never sharp. For the correction of this defect a glass is worn having a cylindrical curve equal to the difference in curvature between the two dissimilar meridians, the axis of the cylindrical surface being carefully adjusted so as to be at right angles to the direction of the meridian to be corrected. The nature of the curve, *i. e.*, whether convex or concave, will depend on whether the refractive power of the meridian to be corrected requires to be strengthened or lessened. As it is obvious that this irregularity of corneal curvature may coexist with a general myopia or hypermetropia, compound glasses are often required, having on one face a cylindrical curve to neutralize the astigmatism, and on the other the proper spherical curve required for the other defect.—The second general way in which glasses operate to assist sight is, as already said, by compensating for failure of certain muscles concerned in the use of the eyes to fulfil their function. The most common of these troubles is want of power to focalize the eye upon near objects. This faculty resides in a little muscle within the eye, by the action of which the convexity, and thus the refractive power, of the crystalline lens is temporarily increased. But the substance of the crystalline lens steadily grows harder, and thus less and less compressible, so that the same amount of muscular action comes to produce less and less effect. The consequence is that during adult life the focalizing power upon near objects steadily diminishes, and hence the nearest point of distinct vision gets further and further from the eye, until at about the age of 47 it has receded beyond the distance for convenient use of the hands. Reading, writing, sewing, or any manual work requiring sharp vision of small objects at the customary distance, then become impossible without artificial compensation for the failure of focalizing power. This condition, which is natural to all eyes, is called *presbyopia* or old-sightedness, and the compensation is very simple. The difficulty being an inability on the part of the eye itself to increase temporarily its refractive power, the needed addition is artificially supplied by a convex glass, which is worn of course only when near objects are to be viewed. As the focalizing power keeps on diminishing until in old age it is wholly lost, the strength of the glasses must be steadily increased. As soon as presbyopia begins to show itself, the proper weak glass should be promptly assumed, as only injury to the eyes, or at least useless inconvenience, can result from a fruitless struggle to do without this aid. In all cases the weakest glass with which ordinary type can be clearly and comfortably seen at the usual distance is the proper one to wear. With normal eyes, individuals of the same age take very nearly the same strength of glass; but, for obvious reasons, in myopes the glass will be weaker in proportion to the degree of the optical defect, while in hypermetropes it will be correspondingly stronger. This same inability to focalize upon near objects may also

occur at any age from inherent weakness or paralysis through disease of the muscle concerned, and in such case, as in true presbyopia, a convex glass will be needed for near work. It was probably to compensate for presbyopia by convex glasses that spectacles were first invented. Roger Bacon first pointed out the benefit to old men and "to those that have weak eyes" of viewing letters through a plano-convex lens. Alessandro di Spina, a monk of Pisa who died in 1313, is generally accredited with having made public the use of spectacles, which were apparently invented some time between 1280 and 1311.—Another form of muscular insufficiency that can be compensated by optical means is where some of the muscles moving the eyeball in its socket are unduly weak. In such case the holding of the two eyes fixed upon the same point is attended by a feeling of straining or actual pain, and upon prolonged effort the overtaxed muscle may suddenly relax, producing immediately a temporary confusion of sight. Here, if the insufficiency be but slight, the wearing of a weak plain prism, properly adjusted, compensates for the defect; for even while the eyes are allowed to keep the faulty relative position enforced by the muscular weakness, the rays coming from the object desired to be seen can, by means of refraction through a prism, be made to enter both eyes in the same direction, the only condition necessary for binocular single vision. But this mode of compensation will only do in slight degrees of muscular insufficiency; in the higher grades a radical cure by a surgical operation is necessary. The strength and position of the prisms will of course be determined by the degree and seat of the muscular weakness; and if, as is often the case, the affection in question is associated with myopia, hypermetropia, or astigmatism, a compound glass may be needed, where one or both faces of the prism bear the necessary curves to correct the optical defect.—The designation of the strength of glasses is nowadays by the fraction expressing the refractive power of the lens in terms of inches, the words "positive" and "negative" or the signs + and — indicating respectively a convex or a concave glass; thus "$-\frac{1}{10}$" means a concave lens of 10 in. focal length. Glasses are commonly ground with an equal curve on both faces, but a meniscus for a positive and a concavo-convex for a negative lens may also be used (see OPTICS), in which case the spectacles are called periscopic. The advantage of this form is, that there is less distortion of objects seen through the edges of the lens; but the disadvantages are, that the glasses are heavier than those of the ordinary style, and give more reflection from their back surface. The material for spectacles is commonly glass, but a variety of rock crystal called "Brazilian pebble" is also used. The latter substance is less apt to scratch or to become dimmed by deposit of moisture on being brought from a cold to a warm temperature, but it is heavier and far more expensive than glass. The claims for its "preserving the sight" are fanciful, and many of the spectacles sold as pebbles are not such at all. It is always important that the lenses should be of first class, the substance without flaw, and the grinding accurate. A convenient test is to hold the glass some distance from the eye, and then, moving it from side to side and to and fro, note if there be any apparent flickering or distortion of objects seen through it. If there be, the glass is worthless. In style of frames, as is well known, there is great variety. In general the word "spectacles" is now used to designate a frame held in place by bows reaching behind the ears, and "eye glasses" one held in the hand or made to clasp the nose. The spectacle frame is the best where the glass has to be continuously worn, as in myopia, as the lenses can be more accurately centred and made to set perpendicular to the line of sight. For temporary use, as for reading glasses in presbyopia, good eye glasses, selected so as to be well centred to suit the distance of the eyes apart, are convenient and unobjectionable. The material for the frames is various; silver was formerly in general use, but has been superseded by steel and gold. Tortoise shell is light, but easily broken; it is only used in eye-glass frames. The frame, whether spectacle or eye glass, should be selected to suit the individual conformation of face and the purpose for which the glass is wanted, so that the line of sight shall be through the centre of the glass and perpendicular to its surface. Hence glasses for distant vision, as in myopia, should be set high and vertical, while for near work only, as in presbyopia, they should be lower and inclined. A style of spectacles was invented by Franklin for special cases where a different glass is needed for far and near vision respectively, in which the glass is bisected horizontally, the two segments being of the different curvatures required, the upper for the far and the lower for the near. 2. *Spectacles for Protection.* To shield sensitive eyes from excess of light, colored glasses, either with plane surfaces or of a watch-glass form, are used. The latter give most protection, as they cut off the side light more perfectly. Still better are goggles with wings at the sides. Shades of blue and "London smoke" neutral tint are the best colors. For protection against the glare of snow or white sand, an opaque disk pierced with a narrow horizontal slit is very efficient. A spectacle frame set with wire gauze or plain glass is sometimes worn by workmen as a protection against bits of flying stone or steel.

**SPECTRUM** (Lat., an image), the name given to the image or colored band formed by the decomposition of a beam of light into its elementary colors. Thus, when a beam of sunlight enters a dark room through a narrow slit, passes through a triangular glass prism, and then falls upon a screen, we may observe

that the beam of light has been spread out by the prism into a wedge-shaped beam of various colors, which falling on the screen forms a *spectrum.* This spectrum of the sun's light may be divided into seven colors, red, orange, yellow, green, blue, indigo, and violet, named in the order of their increasing angular deflection from the direction of the beam of light before it encountered the prism. If the light from the flame of a lamp burning alcohol which contains common salt should enter the slit in place of the sun's light, the spectrum formed on the screen will be found on minute examination to consist only of two closely approximate yellow bands, the remainder of the spectrum which had been obtained with the sun's light being entirely absent. With the light from a flame tinged with the vapor of lithium we obtain a spectrum formed only of two bands, one in the red, the other in the orange. It has thus been found that spectra differ widely, according to the nature of the incandescent substances from which they emanate. Some, as in the case of incandescent solids, like platinum, are continuous and formed of all of the seven colors; others, as in the cases of the spectra of sodium, lithium, and potassium, are formed of colored bands separated from each other by spaces devoid of all light; while again other spectra, like those of the sun and of the fixed stars, are continuous, like those of incandescent solids, but crossed transversely by a multitude of very narrow spaces devoid of light, or nearly so. (See SPECTRUM ANALYSIS.) In the present article we shall consider the spectrum of the sun, and will give in order an account of the manner of its production, of the methods of measuring the lengths of the waves of the various rays composing it, and of the actions of light, heat, chemical decomposition, and fluorescence produced by the different spectral rays when they impinge upon bodies peculiarly constituted to develop and make manifest the above named actions.—Spectra are usually obtained either by the dispersive action of a prism, or by the diffraction of a "grating" formed by cutting with a diamond point on glass or on speculum metal several thousand equidistant and parallel straight lines in the space of an inch. The prismatic spectrum is formed with purity when the sun's light enters a fine slit formed between parallel edges about $\frac{1}{50}$ of an inch apart, and, after progressing into a dark room for 15 or 20 ft., passes through a prism of clear homogeneous glass and then traverses an achromatic lens of about 6 ft. focus. This lens is placed so far from a screen that it forms on it the image of the slit through which the sunlight enters the room, when the prism is replaced by a plane mirror which reflects the rays on to the screen. The prism in the above experiment must be placed at "the angle of minimum deviation;" that is, it must be so adjusted that the incident beam receives the minimum deviation from the refractive action of the prism. Fraunhofer substituted a telescope for the lens and screen, and viewed the spectrum formed at the focus of its object glass, as shown in fig. 1. This instrument is called a spectroscope. A spectrum, formed as just described, is crossed transversely by dark lines of various breadths and degrees of blackness. These lines are unevenly distributed throughout the length of the spectrum; but the same line always occupies the same position when referred to the tint in which it exists. Fig. 2 gives the spectral lines as mapped by Fraunhofer in vol. iv. of the "Memoirs" of the academy of Munich for 1814–'15. To distinguish these lines Fraunhofer designated them by the letters of the alphabet, in proceeding from the red to the violet end of the spectrum. Thus A exists in the extreme red, while H is in the violet near the boundary of the visible spectrum. Fraunhofer mapped in the spectrum 576 lines, and ever since the publication of his drawing these

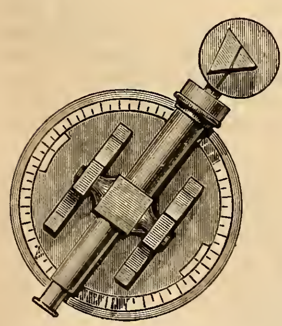


FIG. 1.—Fraunhofer's Spectroscope.

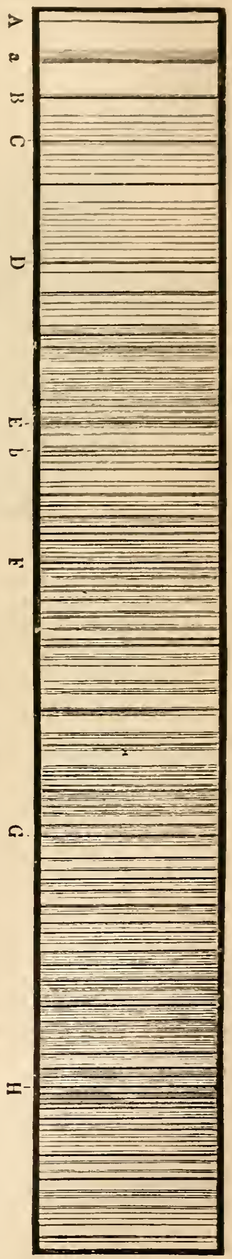



FIG. 2.—Fraunhofer's Solar Spectrum.

lines, and also the invisible lines subsequently discovered beyond the violet and red ends of the spectrum, have been called "the Fraunhofer lines." Subsequent observers modified Fraunhofer's instrument by substituting for the distant slit a collimating telescope (A, fig. 3); this consists of an achromatic lens with the slit at its principal focus. Kirchhoff with the spectroscope shown in fig. 3 has made an exquisite map of the spectrum, containing more than 3,000 lines.—The relative positions of the lines in the spectra obtained from prisms formed of different refracting materials, or even from the same material at different temperatures, differ so much that maps made by different observers are not comparable; hence recourse has been had to spectra formed by transmitting light through gratings. From measurements on these spectra, known as diffraction or interference spectra, can be deduced the lengths of the waves of light corresponding to any tint in the spectrum. The wave lengths are really given corresponding to the fixed lines in the spectrum; and as these lines hold fixed positions in reference to the colors in which they exist, we have unchangeable wave lengths to which to refer any color that may be used in such practical purposes as the determination of indices of refraction or in observations in spectrum analysis. If we look at a distant slit with a telescope before which we have placed a grating, we see a white central image of the slit, just as if the grating were not in front of the telescope; but we observe besides this central white line a series of spectra to its right and to its left. These spectra have their violet ends placed toward the central image of the slit, and they are named in the order of their removal from the slit; as spectrum of the first order on the right or left, spectra of the second, third, fourth, &c., order on the right or left. These spectra are often of great purity, so that hundreds of Fraunhofer lines can be seen with remarkable clearness. If the telescope, T E, be mounted on a divided circle, D, and the grating, G, placed in front of a collimating telescope, C, furnished with the slit at S, as in fig. 4, we can measure in the different spectra the angular distances of these lines from the centre of the image of the slit, and the angular distances from the centre of the image of the slit to the same line in spectra of different orders will be nearly as the number of the orders. Thus, if we call $a$ this angle in the spectrum of the first order, it will be $2a$, $3a$, $4a$, &c., in the spectra of the succeeding orders. It necessarily follows from this fact that the length of the spectrum in any order

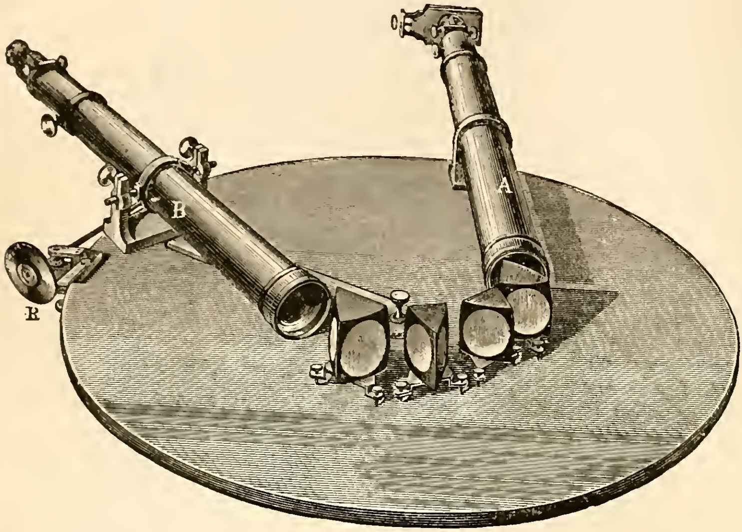


FIG. 3.—Kirchhoff's Spectroscope, by Steinheil.

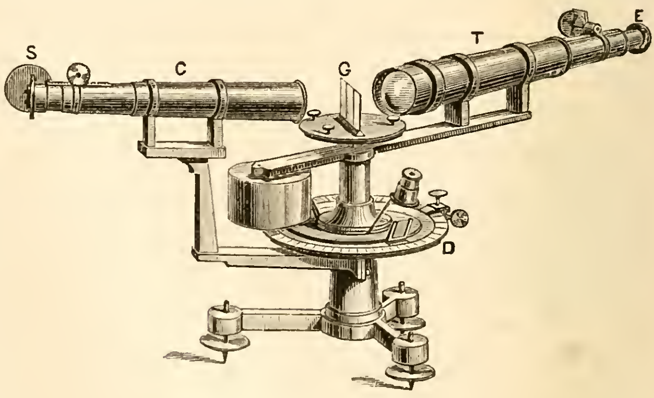


FIG. 4.—Spectrometer.

will be as the number of the order; thus, the spectrum of the third order will be three times as long as that of the first order. It has also been found that the length of the spectrum of any order will be inversely as the distance separating the lines of the grating producing the spectra; thus, the spectrum of the second order produced by a grating of 5,000 lines in an inch will be half as long as that of the second order given by a grating having 10,000 lines in an inch. Let parallel rays of light from a distant point or from the slit of a collimating telescope fall perpendicularly on the plane of the grating G G, fig. 5. The plane of the wave front of the light will be parallel to the plane of the grating, and the vibrations of the ether at each point in the openings of the grating will have the same phase. But whenever light falls upon such constructed apertures as those of the grating, the points in these apertures, situated in the plane of the grating, become centres of origin of vibrations, and the rays which have passed through the apertures diverge in planes at right angles to the lines of the grating. The consideration of the mutual action of these rays will lead at once to remarkable results. All those rays which have traversed the grating in the same direction as that in which they struck it will have the same phase of vibration, and therefore when brought together in the focus of a lens will form there a white image of the distant point or of the slit of the collimating telescope. But it is not so with the parallel rays, which diverge laterally, say in the direction *a e*, *b f*, *c g*, *d h*, &c. If these rays be brought to a focus by means of a lens L, we shall observe at F not a white image of the slit, but a colored one; and it is found that this color will depend on the inclination of the diffracted rays to R N, the perpendicular to the plane of the grating. Suppose that the diffracted rays *a e*, *b f*, *c g*, &c., are so inclined to the plane of the grating that a perpendicular, *b*1, let fall from the centre of one opening in the grating to the parallel ray *a e* emanating from the centre of the contiguous opening, cuts off on the ray *a e* a distance *a*1, equal to the length of a wave of violet light of a definite tint. Also imagine other perpendiculars *c*2, *d*3, &c., let fall in like manner upon the ray *a e*. Then if all of these rays *a e*, *b f*, *c g*, *d h*, &c., be brought to a focus at F, the vibrations of the ether at this point will all have the same phase, and hence will give at F a line which will be formed of violet light; and the intensity of this light will be equal to the sum of the intensities of all the rays *a e*, *b f*, *c g*, &c. The same reasoning will hold good for any other set of rays parallel to those just described, and all symmetrically placed in the openings. Hence all rays emanating from the openings and parallel to the rays *a e*, *b f*, *c g*, &c., and having wave lengths equal to *a*1, will conspire in their vibratory actions when brought to a focus at F. But it is not so with other rays, which, although parallel to the rays *a e*, *b f*, &c., have not the same length of waves as *a*1; for they will not conspire when brought together at F, but will interfere, or in other words will be exactly opposed to each other in vibratory action, and hence will disappear as light when brought to the focus at F. For example, suppose we consider a series of rays of red light which proceed parallel to *a e*, *b f*, &c., and come to focus at F. These rays are formed of waves which are about twice as long as those of violet light, or in other words as *a*1; hence red rays which have emanated from symmetrically placed points in two contiguous openings of the grating and proceed in direction parallel to *a e*, will, on coming to the focus F, all differ by half of an undulation, and hence red light cannot exist at F with an inclination of diffracted ray equal to N *c* F, but can only exist at a point at such an angular distance from R N that the perpendiculars let fall from *a*, *b*, *c*, and *d* on to *a e* cut off on this latter line distances respectively equal to double the lengths *a*1, *a*2, *a*3, *a*4. Again, suppose that the wave lengths of two rays, emanating from symmetrically placed points in two contiguous openings and proceeding parallel to *a e*, differ by only $\frac{1}{1000}$ of the wave length of one of these rays, then these rays will also interfere when brought to focus at F; because the phases of the rays emanating from points symmetrically placed in the 1st and 2d openings of the grating will differ by $\frac{1}{1000}$ of an undulation; those from the 1st and 501st openings will differ by $\frac{500}{1000}$ or half a wave length, and therefore will interfere. The same interference will take place between the rays from the 2d opening and those from the 502d, and those from the 4th and the 504th openings, and so on. Hence rays of light having any other wave length than *a*1 will almost completely disappear as light by their interference, and the light collected at F will be that which is produced by ethereal vibrations of wave lengths equal to *a*1. The same reasoning holds good for any bundle of parallel rays having diffracted angles different from N *c* F, and hence we have a pure spectrum formed at the focus F. It thus appears that there is a connection between the angle N *c* F of the diffracted rays, the length *a*1, and the color observed at F. The color at F varies with the angle N *c* F, or, what is the same, with the length *a*1. For the extreme red rays the angle N *c* F is at its maximum, and *a*1 is

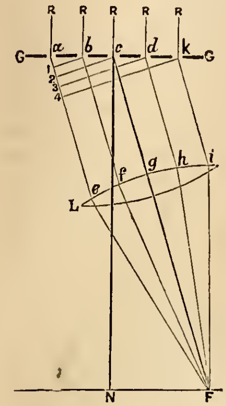



Fig. 5.

equal in length to about ·00077 mm.; for the extreme violet rays the angle N *c* F is at its minimum, and *a*1 is equal to about ·00039 mm.; therefore the violet ends of the spectra will always be toward the image of the slit. The determination of a wave length consists in the measurement of the length *a*1. To measure this length, we first determine the distance between the centres of two contiguous openings in the grating, and then the angle N *c* F corresponding to any given tint or fixed line in the spectrum; and as the angle *a b*1 is equal to the angle N *c* F, *a*1 is equal to *a b* multiplied by the sine of N *c* F. Let *s* stand for *a b*, *d* for the angle N *c* F, and *l* for *a*1, or the wave length; then $l = s \times \sin.\ d$. If the ray *a e*, and symmetrically placed rays, be inclined to the plane of the grating so that the perpendicular *b*1 cuts off on *a e* a distance *a*1 equal to two wave lengths, we shall have the same actions over again, only the spectra produced by them will be more deflected to the side of the image of the slit; and thus are produced the spectra of the 2d, 3d, 4th, &c., orders. The length of any one of these spectra will necessarily be nearly as the number of the order of the spectrum. The wave length of the same tint, or of the same fixed line, can be determined from angular measures made on this tint or line, in the spectra of all orders. From such measures we obtain multiples of the wave length, and the formula for measures on the *n*th order of spectrum becomes $l = \frac{s \times \sin. d}{n}$. In the actual measures which have been made, to form what is called a map of "the normal solar spectrum," the plane of the grating is placed in the axis of a divided circle, and is generally adjusted so that this plane is at right angles to the line of collimation of the collimating telescope carrying the slit. The observing telescope is placed on the other side of the grating, and has attached to it verniers, or reading microscopes, which it carries over the divided circle as it rotates around its axis, as is shown in fig. 4. Measures of the wave lengths of the rays forming the solar spectrum have been made by Fraunhofer (*Denkschriften der münchener Akademie*, vol. viii.; Gilbert's *Annalen*, vol. lxxiv.), Ditscheiner (*Berichte der wiener Akademie*, vols. l. and lii.), Van der Willigen (*Mémoires d'optique physique*, Haarlem, 1868), Mascart (*Comptes rendus*, lviii., p. 111; *Annales scientifiques de l'école normale supérieure*, vol. iv.), Angström (*Recherches sur le spectre solaire*, Berlin, 1869), Eisenlohr (Poggendorff's *Annalen*, vol. xcviii.), and Stefan (*Berichte der wiener Akademie*, liii.). Mascart made an important modification in the process, as above described. In his measures he placed the plane of the grating at such angles to the axis of the collimator that the observed line was seen with its minimum angle of deviation, and thereby obtained greater simplicity of adjustment with superior accuracy in his measures. In his method the formula becomes $l = \frac{2s}{n} \times \sin. \frac{d}{2}$. He came to the conclusion that the upper or more refrangible of the two D lines of Fraunhofer has a wave length of ·0005888 of a millimetre. This result agrees with the determination made by Fraunhofer, and physicists now generally adopt this determination as exact. If the wave length of any one ray is known to the last degree of precision, the position of this ray may afterward serve as a point of departure in the determination of other rays merely by observing their angular departure from this standard ray; and if we knew with certainty the wave length of a definite ray, we might adopt this dimension as a standard of length; for from observations on this ray's angular position in the spectrum, we could determine the distance separating the centres of two contiguous openings in the grating, and hence determine the length occupied by any known number of lines in a uniformly cut grating. The following table gives the wave lengths, in ten millionths of a metre, of the principal Fraunhofer lines, as determined by the observers named:

| FRAUNHOFER LINES. | Fraunhofer. | V. d. Willigen. | Ditscheiner. | Angström. | Stefan. | Mascart. |
|---|---|---|---|---|---|---|
| A | ........ | ·0007609 | ........ | ·0007604 | ........ | ........ |
| *a* | ........ | ·0007189 | ........ | ·0007183 | ........ | ........ |
| B | ·0006878 | ·0006871 | ·0006883 | ·0006867 | ·0006873 | ·0006867 |
| C | ·0006564 | ·0006565 | ·0006571 | ·0006562 | ·0006578 | ·0006561 |
| $D_1$ | ........ | ·0005898 | ·0005905 | ·0005895 | ·0005893 | ·0005894 |
| $D_2$ | ·0005888 | ·0005896 | ·0005899 | ·0005889 | | ·0005888 |
| E | ·0005265 | ·0005272 | ·0005278 | ·0005269 | ·0005271 | ·0005268 |
| $b_1$ | ........ | ·0005186 | ·0005192 | ·0005183 | ........ | ·0005182 |
| $b_2$ | ........ | ·0005175 | ·0005181 | ·0005172 | ........ | ·0005165 |
| F | ·0004851 | ·0004864 | ·0004868 | ·0004860 | ·0004869 | ·0004860 |
| $H\gamma$ | ........ | ·0004342 | ·0004346 | ·0004340 | ........ | ........ |
| G | ·0004292 | ·0004311 | ·0004317 | ·0004307 | ·0004291 | ·0004308 |
| $H_1$ | ·0003945 | ·0003971 | ·0003974 | ·0003968 | ·0003959 | ·0003967 |
| $H_2$ | | ·0003938 | ·0003940 | ·0003933 | | ........ |

—The considerable differences observed in the determinations of the wave length of the same ray by different observers are not alone owing to the variations always existing in honest measures of precision, but chiefly to the difficulty of obtaining regularly ruled gratings, and to the resulting uncertainty in the knowledge of the distance separating the centres of two contiguous openings in the grating. All physicists have until recently obtained their gratings from Nobert. Lewis M. Rutherfurd of New York has for several years past given

much labor to the production of perfect gratings, and an engine (fig. 6) which he has recently made produces gratings more uniformly ruled than any known to us. On a hollow cast-iron block are cut, at right angles to each other, two V-shaped guides. On one of these guides slides the iron plate D, moved by means of a screw acting in a nut attached to its under surface. On this plate is fastened the plane of glass or speculum metal which is to be ruled. On the other guide slides the plate L J, having a reciprocating motion given to it by a lever, the action of which will be described further on. To this plate is attached the tool holder carrying the diamond-pointed cutter. The motive power of the machine is a small turbine from which passes a cord around the driving wheel. On this driving wheel is a pin to which

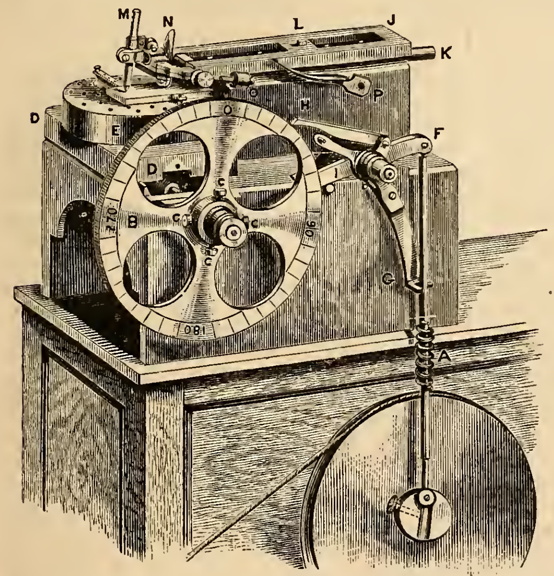



Fig. 6.—Rutherford's Ruling Engine.

is jointed the connecting rod A F. This connecting rod is hollow, and in it moves a rod which is constantly pressed toward the pin on the driving wheel by the spring shown at A. When the rod A F moves upward, the arm F I oscillates on its rocking shaft (the end of which is seen in the figure, projecting horizontally), until the end I of this arm comes against the fixed pin placed under it, and in contact with which it is shown in the drawing. Just before this upward movement of the rod A F begins, the pawl H falls into a notch on the wheel B, which is attached to the screw of the engine, and during the upward motion of the rod A F the pawl H presses against the notched wheel and rotates it a definite fraction of an entire revolution. The pawl H having completed its "throw," the crank pin on the driving wheel passes its upper centre, and then the slotted lever G lifts the pawl out of the teeth of the wheel B, so that no jarrings or tremors are given to the machine while the pawl is retreating to take a fresh hold on the feed wheel B. A pin attached to the connecting rod passes through a slot in the tube A F, and serves to hold the two together when the rod is making its downward motion. The amount of rotation to be given to the feed wheel B is regulated by rotating to the right or to the left the collar on the rock shaft, to which the pawl H is jointed. Directing attention to the plate L J, to which is attached the cradle N carrying the diamond-pointed rod M, we observe at K the right-hand end of a rod the extremities of which pass through holes in the iron frame of the engine. This rod is moved parallel to the V guide of the plate L J by means of an oscillating lever which works in a vertical slot attached to the rod K, and is fixed on the same rock shaft which carries the lever F I. Projecting upward from the rod K is a short rod whose end is shown at L. This rod moves in a short slot cut in the direction of the length of the plate L J, as shown in the figure. The action of the cutting point of the tool M can now be explained. While the pawl H is rotating the feed wheel B, the rod L presses against the left-hand end of its slot and moves the slide J from right to left. The plate J cannot move, as above indicated, until the rod L touches the left-hand end of its slot; and when it reaches this position the left-hand end of the rod K has moved to the left sufficiently to press against the lower point of the cradle N, and hold the diamond-pointed tool M elevated above the plate of glass or speculum metal during the entire left-hand motion of the plate J. When the end F of the lever F I descends, the rod K moves from left to right, and the projecting pin has to move up to the right-hand end of its slot before it can push the plate J to the right. During this motion of L in its slot, the left end of the rod K has allowed the diamond point on M to rest on the glass plate, so that before the plate J begins its right-hand motion the diamond point is at rest on the plate to be ruled. The plate J now moves to the right, and the diamond point cuts a line. But the diamond point is lifted, before the right-hand motion of the plate J ceases, by the side arm O of the cradle N coming against the inclined surface of the side piece P. The diamond is thus raised, and is held in this position by the depression of O against P until the left-hand end of K has moved up to the cradle and holds the tool elevated during the motion of the plate J to the left. After this motion has ceased, the diamond is lowered to the glass plate, and another cut

is made; and so on, the machine working automatically until the plate is ruled. The pitch of the screw is $\frac{1}{48}$ of an inch; hence, by knowing the fraction of the revolution of the screw made between two contiguous cuts, we know the distance, in fraction of $\frac{1}{48}$ of an inch, separating the centres of two contiguous lines on the grating. The diameter of the feed wheel B is 6 in., and from this dimension the reader may estimate the size of the other parts of the engine. The excellence of the work done by this engine depends on certain peculiarities of construction: 1. The errors in the throw of the screw, caused by its eccentricity, or want of coincidence of the axis of figure of the screw and its axis of motion, are corrected by giving to the feed wheel B an eccentricity opposed to that existing in the screw. The screws at C, C, C, C serve to alter the position of the centre of the feed wheel B, and thus to obtain the required eccentricity. This balance of opposing eccentricities is obtained by a delicate and precise method devised by Mr. Rutherfurd. A grating ruled by the engine on speculum metal or silvered glass is examined at such an angle of reflection that the light reflected from the plate appears of one color; for example, red. If we could cause the lines on this grating gradually to approach each other and narrow the spaces separating them, we should observe the red tint becoming gradually lighter in hue, and then gradually changing into orange, yellow, green, &c. Hence uniformity of tint is an indication of uniformity of ruling; therefore, if we tilt a grating placed in front of a flame and examine it by means of a lens and find it of a uniform color, we are sure that the screw is doing accurate work; but if the screw have a periodic error like eccentricity, then we shall observe a columnar appearance on the plate, owing to periodic variations in depth of color. By a careful comparison of the positions of these colors with the known positions of the screw when the corresponding portions of the grating were cut, we ascertain the direction in which to move the centre of the feed wheel B in order to correct the eccentricity of the screw. 2. The nut in which the screw of this engine works is 3 in. long, the threaded portion of the screw being 3½ in. long. This long nut tends to preserve the accuracy of the engine's work. 3. The original method devised by Mr. Rutherfurd to obtain rectilinear V guides is a new and important feature of this engine. A collimating telescope with a vertical slit, or cross threads, at the focus of its object glass, is placed in a firm position in a line with the guide to be tested. On the slide which moves on the V guide is fastened a telescope with cross threads at the focus. The slit of the collimating telescope is viewed in the other telescope as the slide carrying the latter is moved to and from the collimator. If the slit is constantly bisected during this motion, the guide is accurate; but if the image of the slit moves when referred to the cross threads, then the guide has to be corrected until by trial the image of the slit remains stationary during the telescope's motion. 4. The pawl H during its retraction does not fall over the teeth of the feed wheel, and by jarring the machine cause the diamond to cut an irregular or waving line. 5. The method of lifting the diamond point while it is obtaining its position for a new cut is the simplest we know of. 6. The screw of this engine, on which the results mainly depend, is constructed as follows: A screw is first cut in a lathe with a single pointed tool, then scored; it is then hardened, and thus a tap is obtained. This tap is now centred by its threads, and cylinders are ground on its ends so that they are concentric with the threads of the screw. Blocks of metal are now firmly screwed on to the bed plate of a planer, and Vs are cut in these blocks to support the cylindrical ends of the screw tap. A stock holding blank dies is placed in the tool holder of the planer, and these dies are screwed against the screw tap. The stock is then firmly screwed to the tool holder. The threads of the dies are now cut by rotating the screw tap two or three times through the dies; then, relieving the die stock in the tool holder, the dies are again tightened on the screw tap; the stock is now screwed tightly on the tool holder, and the screw tap is again traversed through the dies. This operation is repeated until the dies are finished, when they are hardened. A screw which is to serve for the ruling engine is now cut on the lathe with the same single-pointed tool which cut the thread of the master tap. This screw is nearly finished on the lathe. It is then placed in the same Vs which previously held the master tap, and the dies, just described, are placed in the tool holder of the planer, and with them the thread of the screw is finished. The screw is now rotated on its threads in a long cast-iron V, and shoulders are turned down on the ends of the shaft of the screw. The nut for this screw is cut with a single-pointed tool. The screw is now run into its nut, and they are ground together with finely powdered pumice stone. The screw of this engine has only one collar, on which it turns near the feed wheel B. The other support of the screw is the long nut. Without this arrangement Mr. Rutherfurd found it impossible to cut regular gratings.—*Actions of the Spectral Rays.* A large mass of evidence shows that all of the known emanations from the sun consist of rapid vibrations caused by that luminary in a highly elastic medium, known as ether. We must suppose that this ether fills all known space, for we can only be cognizant of celestial bodies from their vibratory actions on the ether through which they constantly move. The nature of the manifestations of these ethereal vibrations will depend on the nature of the bodies on which they

fall. Thus, what in its essential nature is a mere vibratory motion, we may interpret as light if these vibrations fall on the retina, or as heat if they fall on our skin, or as chemical action if they fall upon a photographer's plate. This preliminary conception established, we can readily interpret the various actions of the spectrum on different bodies, if we also take into consideration the manner in which the spectrum is formed, that is, whether by the diffractive action of a grating, or by the dispersive action of a prism. We should also take into account the nature of the body forming the grating or the prism. The upper portion of fig. 7 shows a prismatic spectrum crossed by the principal Fraunhofer lines, from A to the line O. A photometric examination of this spectrum shows that the distribution of light in it is represented by the curve B, whose heights above points on the base line are in the ratio of the intensities of the light at corresponding points in the spectrum. The maximum of light is found to exist in the yellow at a point distant from the upper D line one third of the distance of this line from the line E. A thermometric examination of this spectrum will give a distribution of heat throughout its length represented by the curve A, and the maximum of heat is shown at a point beyond the extreme red, at a distance equal to that of the line A from the line C. The curve C gives the distribution of chemical action in this spectrum, as found when it falls upon a surface of bromide of silver. The maximum of action is about midway between G and H. It is important to remark that the curves here given only apply to a spectrum which has been formed by this particular kind of glass and has been received on the surfaces indicated. Thus a prism of different glass would change the place of the maximum heat, and the substitution of another chemical surface on which the spectrum falls will cause a shifting of the place of maximum chemical action and a contraction or expansion of the area chemically affected. —*Heat Actions of the Spectrum.* Sir William Herschel in 1800 first discovered that the heat in the spectrum increased from the violet to the red, and reached its maximum intensity at a distance beyond the red "in the invisible rays of the spectrum." He projected the results of his experiments in a curve which bears a close resemblance to the one given in fig. 7. He experimented on these "invisible rays," which he was the first to discover, and showed that they were reflected and refracted according to the same laws that rule in the reflection and refraction of light. He says that "if we may infer the quantity of the efficient from the effect produced, the invisible rays of the sun probably far exceed the visible ones in number." He then condensed these rays by means of concave reflectors and lenses, and made a "trial to render the invisible rays of the sun visible by condensation." He showed "that by condensation their heating power is proportionally increased; for, under the circumstances of the experiment, we find that it extended so far as to be able to raise the thermometer in two minutes no less than 24°." In the same series of researches ("Philosophical Transactions," 1800) he says: "If we call light those rays which illuminate objects, and radiant heat those which heat bodies, it may be inquired whether light be essentially different from radiant heat. In answer to which I would suggest, that we are not allowed by the rules of philosophizing to admit of two different causes to explain certain effects, if they may be accounted for by one. . . . It remains for us only to admit that such of the rays of the sun as have the refrangibility of those which are contained in the prismatic spectrum, by the construction of the organs of sight, are admitted, under the appearance of light and colors; and the rest, being stopped in the coats and humors of the eye, act on them, as they are known to do on all the other parts of our body, by occasioning a sensation of heat." In 1865 Tyndall repeated the researches which had previously been clearly marked out by Herschel. In his first series of experiments he employed the electric lamp as the source of light and heat, and used a linear thermo-battery (see HEAT) as a thermometer. He used prisms of rock salt instead of glass, and in certain of his experiments he passed the beam from the electric lamp through a tank containing a solution of iodine in carbon disulphide. This solution has the property of absorbing all of the radiations producing light, and allowing the invisible rays of heat alone to traverse it. Herschel had already found that the "invisible rays of the sun far exceed the visible in number." Tyndall by similar experiments found that "the thermal energy of the invisible radiation of a very pow-

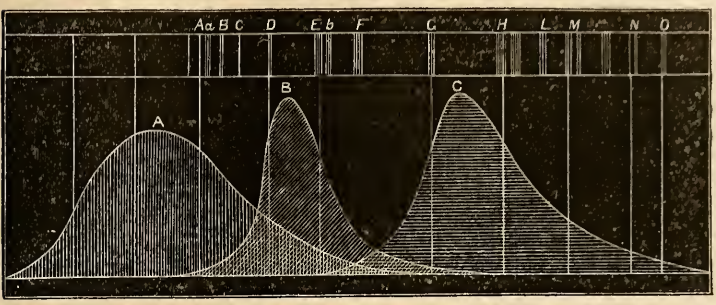



FIG. 7.

erful electric light is eight times that of the visible." Tyndall, with the more efficient means at his command, repeated Herschel's experiments on the condensation of the invisible rays, and caused them to ignite to whiteness solids like platinum. This property of these condensed rays he called "calorescence." Seebeck (*Mémoires de l'académie*, Berlin, 1819) first showed that the position of maximum heat in the spectrum changes with the nature of the prism, and sometimes occurs in the red. Melloni (*Journal de l'institut*, vol. i., p. 212) proved that the effects observed by Seebeck were owing to the absorptive action of the materials of the prisms, and with prisms filled with water and alcohol he observed the maximum temperature in the yellow. In a spectrum which Melloni obtained by passing the sun's rays through a prism of rock salt (the most diathermanous of all substances), he found the maximum of heat beyond the red rays at a distance from the line B nearly equal to the distance of this same line B from the line F. Melloni used the thermo-battery of Nobili for a thermometer. Sir John Herschel ("Philosophical Magazine," April, 1840) examined the distribution of heat in a spectrum by using paper covered on one side with lampblack and then moistened with ether or alcohol. On allowing the spectrum to fall on the uncoated side of the paper, he observed the rate of evaporation of the ether, and thus saw the superior heating effect of the rays beyond the red; and by this method he also detected the existence in the invisible spectrum of athermic bands, which corresponded to the Fraunhofer lines seen in the visible spectrum. In 1843 Dr. J. W. Draper of New York obtained photographs of these bands by projecting a spectrum on a daguerreotype plate, while the latter was at the same time exposed to a diffused light of feeble intensity. In 1847 Fizeau and Foucault, by means of minute mercurial thermometers, detected in the spectrum of a flint glass prism a large athermic band beyond the red, at a distance from the line A equal to the distance of this line from D. In 1871 Lamansky, with a linear thermo battery ("Philosophical Magazine"), confirmed the observations of Herschel. The most recent research on the distribution of heat in the spectrum is by Dr. J. W. Draper ("American Journal of Science," 1872). He maintains that the observed increase of heat in the spectrum, as we proceed to its red end and advance beyond this point, is owing to the fact that any prism by its unequal refractive action on the spectral rays must give a spectrum which is abnormally condensed at its red end and dilated at its violet. He calls attention to the fact that the middle of the normal or diffraction spectrum is at the point where falls the ray whose wave length is ·0005768 of a millimetre. This is a point a little above the line D. The distribution of the rays in the prismatic spectrum of a flint glass prism compared with the normal spectrum is shown in fig. 8, where the two spectra have the same length, and their optical centres, as given by wave length, are in the same line. From a long series of experiments on the spectra obtained by prisms of flint glass, rock salt, carbon disulphide, and quartz, Dr. Draper infers that the amount of heat contained in the visible normal spectrum from its optical centre to the line $H_2$ is equal to the heat contained in the same spectrum from its optical centre to the line A. "Assuming this as true," he says, "it necessarily follows that in the spectrum any two series of undulations will have the same heating power, no matter what their wave lengths may be." It appears that this conclusion is too extended a deduction from such a restricted result as Draper reached; for if the variations of heat in the spectrum were symmetrically divided by a line drawn through its optical centre, the same result would be attained by Draper's method of experimenting. In other words, if the maximum or minimum of heat existed at the optical centre, and the heat declined uniformly above and below this point, or if a series of maxima and minima were symmetrically distributed above and below the optical centre, then each half of the spectrum, divided at its optical centre, would give the same heating power. Recently E. Lundquist (Poggendorff's *Annalen*, vol. clv.) has shown how Cauchy's formula, which serves to connect the index of refraction of a ray with its wave length, may lead to an expression which serves to reduce the distribution of heat observed in a prismatic spectrum to what it would be in a normal spectrum. He finds that the observations of Lamansky, made with flint glass and rock salt prisms, when thus reduced place the maximum of heat about the middle of the normal spectrum, and the heat diminishes uniformly on both sides of this point. In the spectrum of the electric light, however, the maximum of heat is near the line A; hence in this case the optical centre of the spectrum does not divide it into two portions having equal heat-giving powers.—*Chemical Actions of the Spectrum.* Conclusions as to the distribution of chemical action in the spectrum have generally

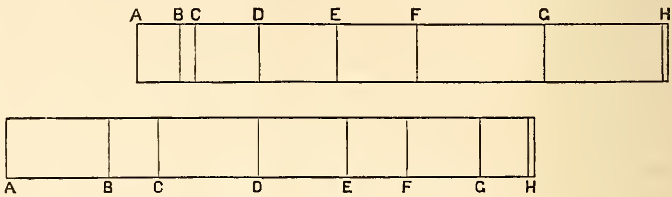



Fig. 8.

been reached solely from the observed actions on compounds of silver; and what is often styled "the curve of chemical force" in the spectrum we have given in fig. 7. This curve is generally referred to as giving the distribution of chemical action in all cases. This is erroneous; as long ago as 1842 Dr. J. W. Draper showed: 1, that so far from chemical influences being restricted to the more refrangible rays, every part of the spectrum, visible and invisible, can give rise to chemical changes, or modify the molecular arrangement of bodies; 2, that the ray effective in producing chemical or molecular changes in any special substance is determined by the absorptive property of that substance. He found that if a spectrum be received on iodide of silver formed on the silver plate of the daguerreotype, and the impression of the light be then developed, after it has acted for a moderate time we shall observe a stain which corresponds in character and position to the blackening effect that under like circumstances would be found on any common sensitive silver paper. If, however, the action of the light be long continued, a white stain makes its appearance over all the less refrangible regions of the spectrum. But if the daguerreotype plate during its exposure to the spectrum be also receiving diffused light of little intensity, it will be found on developing that the impression obtained differs strikingly from the preceding. Every ray that the prism can transmit, from below the extreme red to beyond the extreme violet, has been active. The ultra red athermic lines are present. The impression of these lines is a proof of proper spectrum action, and distinguishes it from that of diffused light, arising either from the atmosphere or from the imperfect transparency of the prism. In a series of photographic prints accompanying a paper by Dr. Schultz Sellak "On the Sensitiveness to Light of Haloid Salts of Silver, and on the Connection between Optical and Chemical Absorption," may be observed the varying extent of the chemical action of the spectrum and the shifting of the place of maximum action depending on the nature of the chemical preparation on which the spectrum is formed. Thus, chloride of silver collodion is acted on by the portion of the spectrum from about half way between the lines G and H up to the line N, fig. 7. Iodide of silver collodion is affected from below G nearly to the line M; bromide of silver collodion from F to M. A mixture of silver salts formed of the iodide and bromide of collodion is sensitive to the action of the spectrum in the space from the line E to the line M. Mixed iodide and chloride of silver collodion are acted on throughout nearly the same area. The remarkable increase of sensitive area when the spectrum falls on the above named mixtures has long been turned to good account in practical photography. (See PHOTOGRAPHY.) The most remarkable confirmation of Draper's first proposition, as given above, is in the case of the spectral action on a surface of West India bitumen. A glass plate is coated with this substance as follows: The bitumen is dissolved in benzine, and the solution poured on a glass plate in a dark room and drained off, leaving a film of bitumen sufficiently thin to be iridescent. This is exposed to the spectrum for five minutes, and then developed by pouring over it a mixture of benzine and alcohol, which will now only dissolve those portions of the film that have not been acted on by the light. The beginning of the impression is below the line A, its termination beyond H. Every ray in the spectrum acts. The proof is continuous except where the Fraunhofer lines fall. Dr. Draper found that the decomposition of carbonic acid gas by plants is accomplished by rays between the lines B and F, which is another instance of the chemical action of the less refrangible rays. In 1842 Sir John Herschel discovered that the yellow stain imparted by the *corchorus Japonica* to paper is whitened by the green, blue, indigo, and violet rays. The rose red of the ten weeks stock is in like manner changed by the yellow, orange, and red. The rich blue tint of the *viola odorata*, turned green by sodium carbonate, is bleached by the same group of rays, that is, by those less refrangible than the yellow. The green chlorophyl of the elder leaf is changed by the extreme red. To a former experimenter, Grotthus, we owe the discovery of the law under which these decompositions of the colors of flowers take place. This law in repeated instances was verified by Herschel, and more recently by Draper. It may be thus expressed: The rays which are effective in the destruction of any given vegetable color are those which by their union produce a tint complementary to the color destroyed. Even the partial establishment of this law, already accomplished, is sufficient to prove that chemical effects are not limited to the more refrangible portions of the spectrum, but can be occasioned by any ray. The second proposition of Draper, that the rays which act chemically on a substance are those which are optically absorbed by it, has received ample independent confirmation by the recent experiments of Sellak in his paper cited above. Sellak found that optical and chemical absorption of light exactly coincide. All colors which are sensibly absorbed (optically) by the haloid salts of silver, of a thickness of a few millimetres, produce chemical decomposition. The optical absorption of transparent plates of these substances is shown by spectral observation to be confined exactly within the limits of chemical action. This is especially the case with mixtures of iodide and bromide of silver. Chloride of silver is colorless, iodide of silver is transparent light yellow, bromide of silver is somewhat deeper yellow, and the mixture of the last two orange yellow.—E. Becquerel in 1842 (*Bibliothèque Universelle de Genève*) was the first to photograph the Fraunhofer lines, and in doing so

he discovered that similar lines existed in the invisible portion of the spectrum, formed of rays more refrangible than the violet. In 1843 Dr. Draper obtained independently the same results. Müller, in the sixth edition of his *Lehrbuch der Physik*, gives a photographic print of the spectral lines extending from a short distance below G to above R. He made this photograph with a prism and lens of quartz. Subsequently Mr. Rutherfurd obtained, with two prisms of carbon disulphide, a superb photograph embracing lines extending from near *b* to a considerable distance above the upper of the H lines. This photograph has excited universal admiration. It is crowded with lines which are not drawn on the maps of Kirchhoff or of Angström. Mascart of Paris obtained the Bordin prize of the academy of sciences for his determinations of the wave lengths of the visible and ultra violet rays of the spectrum. He used a grating of Nobert to obtain his spectra, and measured the wave lengths of the more refrangible invisible rays by obtaining photographs on small glass plates placed in the ocular E of the spectrometer shown in fig. 4. By this means Mascart measured the wave lengths of these invisible rays with a precision little inferior to that obtained in his measures on the visible rays. He also measured the wave lengths of the light lines given in the spectra of volatilized metals, and found that cadmium gave the most extended spectrum of invisible rays. Mascart observed rays whose wave length was only ·00022 of a millimetre. The period of vibration of these shortest waves, compared with the period of the longest visible rays of ·00076 of a millimetre, gives about two octaves of the musical scale; that is, the numbers of their vibrations in the same time will be as 1 : 4. But the ratio of the wave length ·0019 of a millimetre of the least refrangible invisible ray of the spectrum to the shortest invisible ultra violet wave of the spectrum will be as 1 : 8, or as any note is to its upper third octave. The papers of Mascart can be found in the *Annales de l'École normale*. In 1873 Dr. Henry Draper of New York published in the "American Journal of Science" a carbon print of a remarkably perfect photograph of a spectrum produced by one of Rutherfurd's diffraction gratings of 6,481 lines to the inch. The negative was photographed on collodion, and the published carbon print has attached to it a scale giving the wave lengths of the rays. This print was obtained by transferring the original negative to a thick plate of glass by a process known as the albertype, and using the glass in a printing press in the same manner as a lithographic stone. This print therefore represents the work of the sun itself, and is not a drawing either made or corrected by hand. The print consists of two portions. The upper gives all the lines of the spectrum from near G to O, or from wave length ·0004350 mm. to ·0003440 mm. Above this is placed a scale, which is a copy of Angström's from just below G to $H_2$, with the same sized divisions carried out from $H_2$ to O. The lower part is a magnified portion of the same negative, having $H_1$ and $H_2$ about its middle, and extending from wave length ·0004205 to ·0003736 mm. Between wave lengths ·0003925 and ·0004205 mm., Angström's map has 118 lines, while Draper's has 293. We here give a table of the wave lengths of ultra violet rays according to the measurements of Mascart and of H. Draper:

| FIXED LINES. | Mascart. | Draper. |
|---|---|---|
| $H_1$........................ | ·0003967 mm. | ........ |
| $H_2$........................ | ........ | ·0003930 mm. |
| L........................ | ·0003819 | ·0003821 |
| M........................ | ·0003729 | ·0003728 |
| N........................ | ·0003580 | ·0003580 |
| O........................ | ·0003440 | ·0003440 |
| P........................ | ·0003360 | ........ |
| Q........................ | ·0003286 | ........ |
| R........................ | ·0003177 | ........ |

—*Fluorescent Action on the Spectral Rays.* Fluorescence is a property possessed by certain substances of absorbing light composed of rays of a certain wave length, and then emitting this light changed into rays of a longer wave length; or, what is the same, changed into light of a lower refrangibility. This phenomenon was first observed by Robert Boyle; an account of his experiments may be found in vol. i. of his works (London, 1772). The

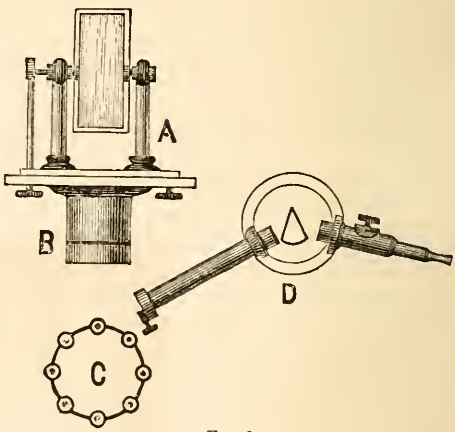



FIG. 9.

method of examining the spectra of fluorescent bodies is as follows: A porte-lumière, A, fig. 9, reflects the sun's rays on to a lens at B. which concentrates the light on the fluorescent substances contained in bottles at C. By the revolution of the stand on which these bottles are placed, they can be brought successively before the slit in the collimating telescope of the spectroscope D. Before the solar rays fall on the fluorescent substance they pass through a tank, placed between B and the spectroscope,

and containing a solution of cupric sulphate in ammonia. The general phenomena of fluorescence are described under FLUORESCENCE; we here add several discoveries made since the writing of that article by Prof. Morton of Hoboken. In a portion of his researches Prof. Morton had the coöperation of Dr. H. C. Bolton of New York, who undertook the chemical work in the investigations. Their attention was particularly directed to the fluorescent properties of the uranium salts. The total number of distinct salts produced and examined so far by these investigators is 75, not including numerous specimens treated in various ways to establish the existence and conditions of their several hydrates. This multiplication of facts has given great value to this research as compared with previous work in the same direction. Thus, where Becquerel has examined one double acetate, these investigators have examined 16; in place of his three double sulphates, they have 16; in place of one fluoride, six; and so on. The methods pursued in the examination of these uranium salts were the same as those of Stokes and Becquerel. The discoveries made by Morton were mainly due to the wider range of substances examined, which made it possible to form inductions and generalizations, and to the scrupulous attention paid to the purity of these substances. We note only the most important results, and refer the reader to the following original papers for additional information: "American Chemist," vols. iii. and iv.; "Chemical News," vol. xxviii. 1. By a comparison of the spectra of 17 acetates and double acetates of uranium in the solid state and in aqueous solutions, the remarkable fact was demonstrated that in the case of these bodies no double salt could exist in solution in water. By further experiments of the same kind this law was extended to all the known salts of uranium. 2. It was proved that by the study of the fluorescent spectra the existence of a new and before unknown salt could be recognized. Thus, on heating the ammonio-uranic sulphate to 100° C. for a short time, it was noticed that its fluorescent spectrum assumed a duplicate character (see spectrum 2 of fig. 10), a new set of bands being added to those of the normal salt (see spectrum 1 of fig. 10). By continuing the heating until the salt ceased to lose weight, a substance was obtained giving spectrum No. 3 of fig. 10. These results naturally suggested that the two spectra 1 and 3 belonged to the hydrated and anhydrous salts, and that spectrum 2 indicated

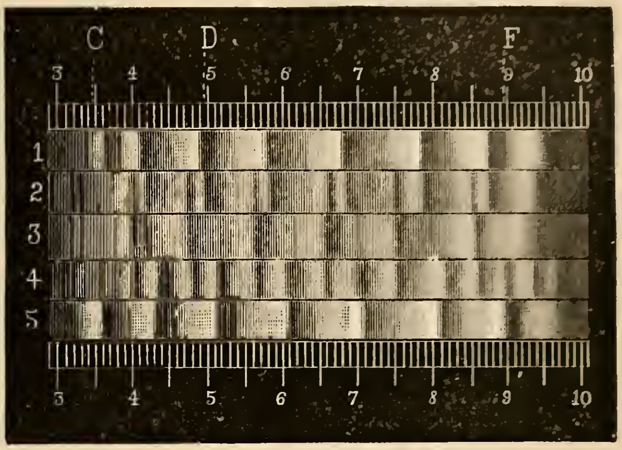



FIG. 10.

a mixture of the two. On heating the dried salt to low redness for a short time, another double spectrum, No. 4, was developed, which by a continuance of the same treatment was reduced to a new simple one, No. 5. Analysis of the product so obtained showed that it was an ammonio-diuranic sulphate, a salt before unknown and not likely to have been discovered by any other means, as contact with water at once reduces it to a mixture of the normal salt and uranic sulphate. 3. It was discovered that certain uranic salts were capable of combining with definite proportions of water to form certain hydrates not heretofore recognized, and that each of these hydrates yielded a perfectly distinct and characteristic spectrum. Thus, the double sulphate of sodium and uranium seems to form no less than five hydrates with from one to five atoms of water respectively. These salts have not all been isolated,

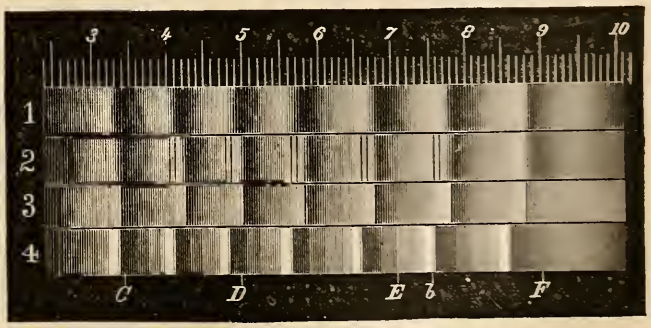



FIG. 11.

but fig. 11 shows the spectra of some of them. Thus No. 1 of the figure is the spectrum of the pentahydrate; No. 2, that of a mixture of three hydrates; No. 3, that of the monohydrate; and No. 4, that of the anhydrous salt. 4. In the case of the double acetates it appears that the position of their bands both of fluorescence and of absorption has a close relation to the atomic weights of the salts. Thus, a list of these salts in the order in which their bands occur, beginning with those which are highest in the spectrum, will be essentially a list of the salts in the order of their atomic weights. 5. It was found that heat had invariably the effect of sending toward the red end of the spectrum all spectral bands of solids and of solutions in all cases where any effect could be observed. In a later memoir Prof. Morton, having investigated the fluorescent relations of the basic salts of uranic oxide, has shown many new ways by which these bodies may be produced, and has found that they yield by fluorescence a light which gives a continuous spectrum. The latter property affords a ready means of distinguishing them, when either alone or in mixture, from hydrates and uranates, which they otherwise often resemble. The same methods of investigation have been applied by Prof. Morton to the following solid hydrocarbons found in the latter products of the destructive distillation of coal tar: anthracene, chrysogen, pyrene, and chrysene. He has also discovered a new hydrocarbon of very remarkable fluorescent properties occurring in the products of the destructive distillation of the heavier petroleum oils; to this he has given the name of thallene, from the vivid green color of its fluorescent light. When a continuous spectrum is thrown on a screen of white paper, half of which is coated with thallene, the effect indicated in fig. 12 is seen. The portion R V, on the paper, shows the usual solar spectrum from red to violet, but the part S T, on the thallene, does not appear, from 8 of the scale upward, blue, indigo, and violet, but appears green of varying intensity. The energy

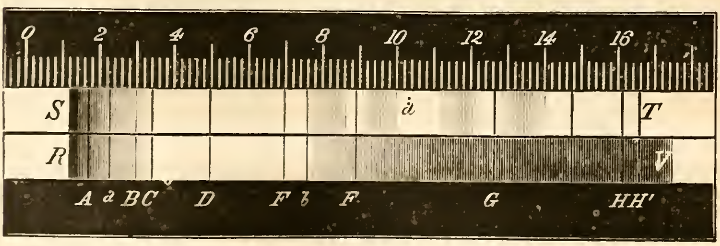



Fig. 12.

of the fluorescent action of this body makes it available for some very striking illustrations. Thus designs painted in it on muslin may be invisible in yellow light, but flash out with a self-luminous light when violet light falls upon them. When a pure spectrum is thrown on the side of a tank containing a solution of thallene in benzole, the appearance indicated in fig. 13 is seen. The trails of light are of the following colors: olive green, bright emerald green, sky blue, and indigo running into violet. The value of the applications of spectrum anal-

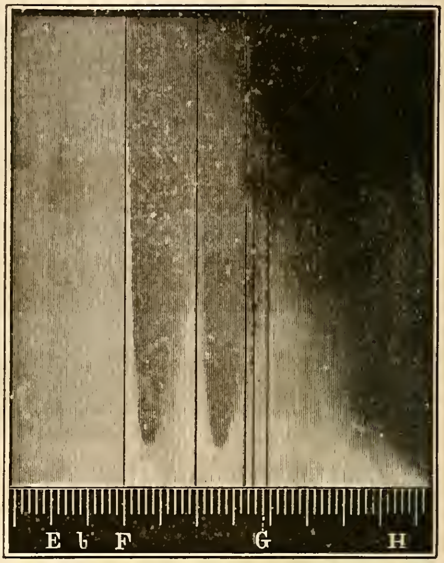



Fig. 13.

ysis to fluorescent phenomena, as developed by Prof. Morton, consists in its opening a new method for investigating chemical and physical changes in bodies while these changes are in progress, and under conditions which would seem to exclude all other means of examination.

**SPECTRUM ANALYSIS,** the name given to a recent method of chemical analysis, conceived and proposed in general form by Prof. G. Kirchhoff of Germany, in which the presence of certain chemical elements is determined by corresponding and peculiar sets of colored bands, imparted by those elements or compounds containing them to the spectra obtained from flames in which such substances are sublimed or volatilized. In reference to the solar spectrum and the transverse dark bands or lines of Fraunhofer marking it, see SPECTRUM; see also SUN. In 1802 Wollaston prepared the way for the discoveries of Fraunhofer, Kirchhoff, and others, by the invention of a new method of observing the solar spectrum. He admitted the solar rays into a dark room through a narrow slit, and placing him-

self at a distance of 12 ft. or more he viewed this slit through a prism of homogeneous glass held close to the eye. This method of observation shows the spectrum crossed transversely to its length by dark lines and bands; and hence the spectrum from a prism of given material and angle becomes a sort of scale or map, to a fixed position in which every gradation of hue and every dark band can be exactly referred. Among the observations upon the spectrum, partially anticipating Kirchhoff's principle, were those of Fraunhofer (1815), of Talbot (1826), of Brewster (1832), of Wheatstone (1835), and of Foucault (1849). In 1855

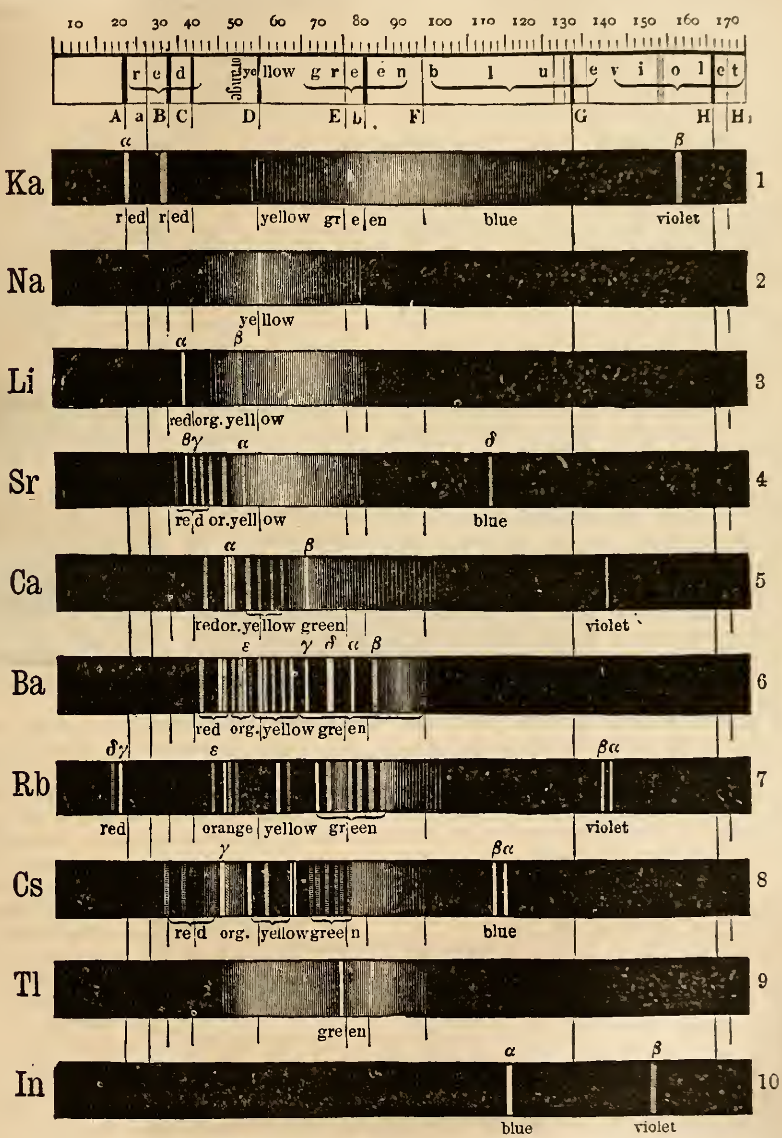



Fig. 1.—Table of Spectra according to Kirchhoff and Bunsen.

Prof. A. J. Angström of Sweden, applying Euler's principle of the reciprocation and absorption by bodies of the same sorts of undulations which they are capable of emitting when themselves originally excited, was led to the view that any body at a glowing heat emits the same rays (refrangibilities) of light and heat as, in the like condition, it will absorb if they impinge upon it. The first decisive and general proof in reference to light of the principle assumed by Euler and Angström was furnished by Kirchhoff's experiments in 1859, with flames

charged with lithium and sodium. A volatilizable compound of any such element being burned in or otherwise diffused through a flame, the incandescent particles of each communicate to the general light of the flame an excess of certain rays, these appearing in the spectrum as brighter bands crossing it in certain parts and having the exact colors proper to such parts, being generally different in situation and hue for the different elements introduced into the flame, and always or generally the same for each element. Fig. 1 shows the spectra of various chemical elements, the symbols of which are given on the left of the spectra. The upper spectrum is that of the sun, and on it are drawn the dark lines of Fraunhofer. (See SPECTRUM.) These lines are extended downward and through the lower spectra, and they thus serve as a kind of scale to which to refer the luminous bands of these spectra. The colored spectral bands are designated by the letters of the Greek alphabet, and are named in order of their importance as characteristic of their respective spectra. When, however, a flame is thus colored, or charged with excess of certain rays, if through this the light of another and more brilliant flame colored with the same element is passed to be analyzed, it is seen that while the general illumination of the spectrum is increased, the previous bright lines characterizing the element are now replaced by dark lines or lines relatively very faint; in a word, the spectrum characteristic of the given element is exactly reversed. The lower dark portion of fig. 2 shows the two bright lines of the spectrum of incandescent sodium vapor; the upper portion of the figure shows these lines reversed by the passage of the light from an incandescent solid through the vapor of sodium. (For an engraving and description of the spectroscope, the instrument with which spectrum analysis is effected, see SPECTRUM.) In the prosecution of the new field of research opened by these experiments, Prof. R. Bunsen soon became associated. When several elements which show systems of bright bands are at the same time in the flame, it is at least generally true that their several spectra coexist; and the instances in which certain lines proper to different elements coincide are as yet few. The spectrum of sodium consists of two approximate bands in the yellow of the spectrum near the orange, and seven relatively very faint lines; and Bunsen has determined that by it the presence in a flame of less than the $\frac{1}{180,000,000}$ part of a grain is detected. Of calcium, barium, strontium, potassium, and lithium, the least quantities detectible vary from $\frac{1}{60,000}$ to $\frac{1}{100,000,000}$ grain; so that no other chemical test approaches this in delicacy. Among results of the new analysis are, the finding that lithium is in fact an element widely diffused in nature, and the discovery of several new metals. (See CÆSIUM, INDIUM, RUBIDIUM, and THALLIUM.)—This method of analysis has proved of great service in metallurgical operations. The application of the method to researches in solar physics will be briefly noticed under SUN. Kirchhoff, having satisfied himself that the bright lines characteristic of several of the metals correspond exactly in place with as many dark lines of the solar spectrum, as shown in fig. 3, infers that these dark lines are produced by a reversal similar to that above shown, and hence indicate the existence of corresponding chemical elements, both volatile in the luminous atmosphere of the sun, and also incandescent in its nucleus. The following table by Angström shows the number of lines belonging to the elements named which correspond with dark lines of the solar spectrum:

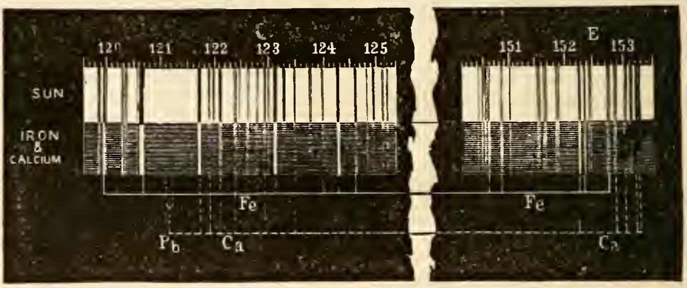


FIG. 3.—Coincidence of the Fraunhofer Lines with the Lines of Iron and Calcium.

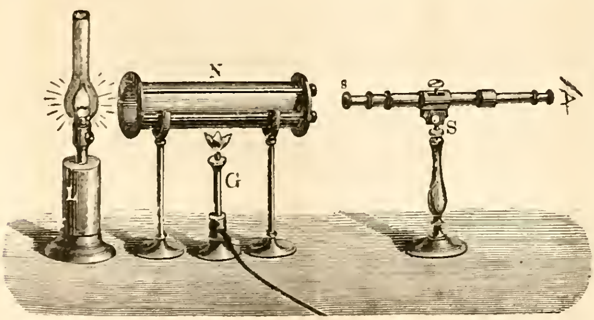


FIG. 2.—Reversal of the Sodium Line (seen with the Spectroscope).

| | | | | | |
|---|---|---|---|---|---|
| Hydrogen. | 4 | Aluminum... | 2 ? | Nickel........ | 33 |
| Sodium.... | 9 | Iron.......... | 450 | Zinc.......... | 2 |
| Barium... | 11 | Manganese.. | 57 | Copper....... | 7 |
| Calcium... | 75 | Chromium .. | 18 | Titanium..... | 200 |
| Magnesium | 4+(3 ?) | Cobalt.. .... | 19 | | |

—Spectroscopic analysis applied to the stars has shown that they resemble the sun in general constitution and condition. But characteristic differences exist, insomuch that the stars have been divided into four orders distinguished by their spectra, types of which are given in fig. 4. These are thus presented by Secchi, who examined more than 500 star spectra: The first type is represented by $\alpha$ Lyræ, Sirius, &c., and includes most of the stars shining with a white light, as Altair, Regulus, Rigel, the stars $\beta$, $\gamma$, $\epsilon$, $\zeta$, and $\eta$ of Ursa Major, &c. These give a spectrum showing all the seven colors, and crossed usually by many lines, but always by the four lines of hydrogen, very dark and strong. The breadth of these four lines indicates a very deep, absorptive stratum at a high temperature and at great pressure. Nearly half the stars observed by Secchi showed this spectrum. The second type includes most of the yellow stars, as Capella, Pollux, Arcturus, Aldebaran, $\alpha$ Ursæ Majoris, Procyon, &c. The Fraunhofer lines are well seen in the red and blue, but not so well in the yellow. The resemblance of this spectrum to the sun suggests that stars of this type resemble the sun closely in physical constitution and condition. About one third of the stars observed by Secchi showed this spectrum. The third type includes Antares, $\alpha$ Orionis and $\alpha$ Herculis, $\beta$ Pegasi, Mira, and most of the stars shining with a red light. The spectra show bands of lines; according to Secchi there are shaded bands, but a more powerful spectroscope shows multitudes of fine lines. The spectra resemble somewhat the spectrum of a sun spot, and Secchi has advanced the theory that these stars are covered in great part by spots like those of the sun. About 100 of the observed stars belong to this type. The fourth type differs from the preceding in the arrangement and appearance of the bands. It includes only faint stars. A few stars, as $\gamma$ Cassiopeiæ,

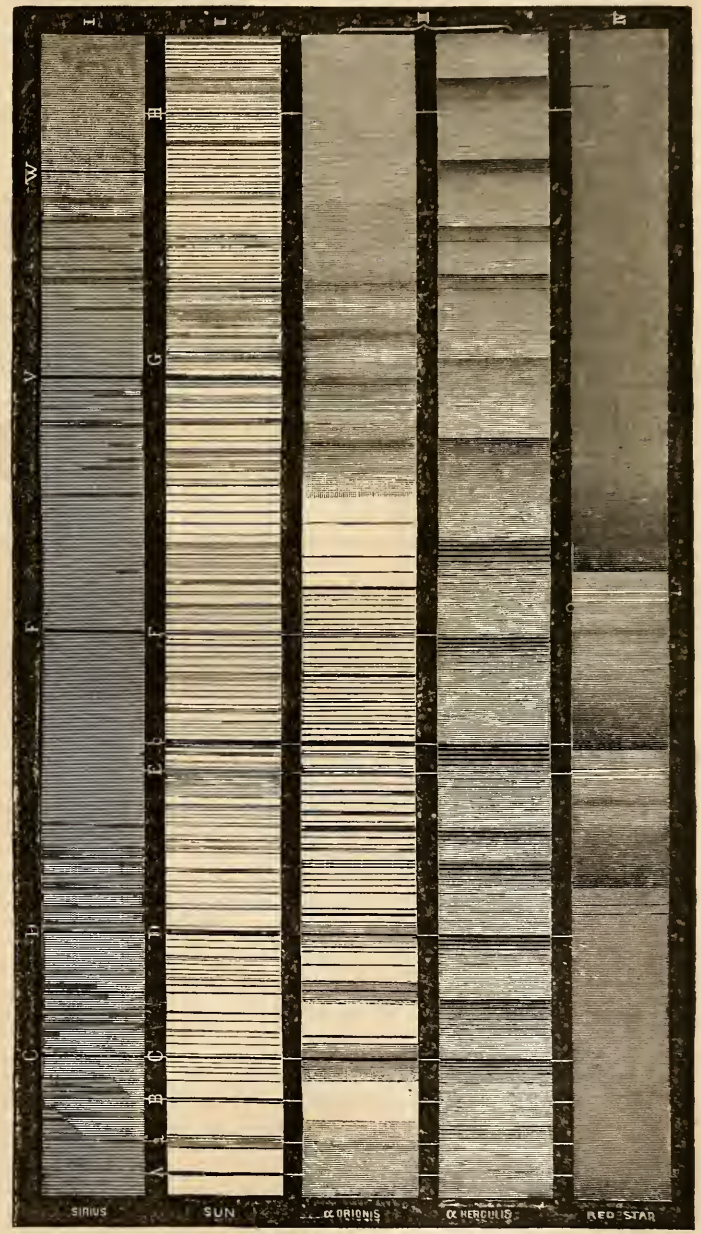


Fig. 4.—Secchi's Types of the Fixed Stars.

η Argûs, β Lyræ, &c., show the lines of hydrogen bright instead of dark, as though surrounded by hydrogen glowing with a heat more intense than that of the central orb itself around which the hydrogen exists. Secchi's observations were comparatively rough, and the inference that particular lines, as those of hydrogen for example, are really present depended in his case simply on the general correspondence of a set of lines with the set belonging to the element. But Huggins and Miller, in England, showed, by the direct comparison of stellar with terrestrial spectra, that certain elements exist in particular stars. Thus they found in the spectrum of Aldebaran lines corresponding with those of hydrogen, sodium, magnesium, iron, tellurium, calcium, bismuth, antimony, and mercury. In the spectrum of Betelgeuse they recognized the lines of sodium, magnesium, iron, bismuth, and calcium, but found those of hydrogen wanting. They discovered that (at least in the instances examined by them) the colors of the double stars are due to the existence of stellar atmospheres exercising an elective absorption. For example, the spectrum of the orange component of the well known double star Albirco shows dark bands in the blue and violet; while the spectrum of the blue component shows many strong lines in the orange and red.—The nebulæ show two orders of spectra. One class, including the clusters, resolvable and suspected resolvable nebulæ, besides other nebulæ which probably are resolvable into stars though no signs of the fact can be detected with the telescope, show a spectrum resembling the stellar spectrum in general characteristics, though usually too faint to be assigned to any given order of stellar spectra. The other class, which includes all the irregular and planetary nebulæ, besides most of the elliptic irresolvable nebulæ, the ring nebula in Lyra, the dumb-bell nebula, and others, presents the remarkable phenomenon of a spectrum of three bright lines (in a few cases four lines are seen). Fig. 5 is the spectrum of the nebula known as H 4,374. This is a small but bright object, and it is the nebula to which Huggins in 1864 first directed his telespectroscope. One line agrees in position with a hydrogen line, another with a nitrogen line, but the third line has not yet been shown to coincide with a line of any known element.—Comets show a mixed spectrum, the nucleus, coma, and tail each giving a combination (though in varying proportions) of a discontinuous or band spectrum, and a continuous spectrum due probably to reflected sunlight. Tempel's comet (1866) was the first analyzed with the spectroscope, by Huggins in England. Winnecke's (1868) was the first to which careful analysis was applied, with the curious result of observing that the bands agree in position with those obtained as the spectrum of carbon, by passing the electric spark through olefiant gas. Huggins obtained the same result (which was confirmed by Professors Harkness and Young in America) from the study of Encke's comet in 1872. The first large and long-tailed comet studied with the spectroscope was Coggia's comet of 1874. Huggins gives the following account of the spectroscopic analysis of this comet: "When the slit of the spectroscope was placed across the nucleus and coma, there was seen in the instrument a broad spectrum, consisting of the same three bright bands exhibited by comet II., 1868, crossed by a linear continuous spectrum from the light of the nucleus. On the continuous spectrum of the nucleus I was not able to distinguish with certainty any dark lines of absorption, or any bright lines, other than the three bright bands. Besides these spectra, there was also present a faint broad continuous spectrum between and beyond the bright bands. When the slit was moved on to different parts of the coma, the bright bands and the faint continuous spectrum were found to vary in relative intensity. When the slit was brought past the nucleus on to the commencement of the tail, the gaseous spectrum became rapidly fainter, until, at a short distance from the nucleus, the continuous spectrum predominated so strongly that the middle band only, which is the brightest, could be detected on it."—The planets, shining by reflected light, can only reveal under the spectroscope the possible presence of absorptive vapors in their atmosphere. (See MARS.)

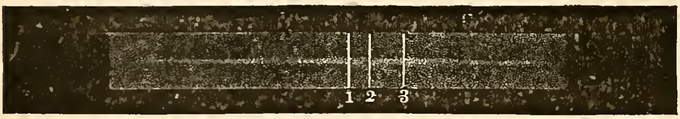


FIG. 5.—Spectrum of Nebula (H 4,374).

**SPECULUM** (Lat., mirror), a term commonly applied to concave metallic reflectors, such as are used in reflecting telescopes for concentrating the rays of light from distant luminous bodies, and presenting the image of these in their focus. Their perfection consists in large surface, whereby they collect the greatest quantity of light; in the highest possible polish, whereby it is reflected with least loss; and in the most exact parabolic curvature, rendering the image distinct and precise. In a speculum of 6 ft. diameter, a variation even at its edge from the true parabolic curvature, so minute as to escape detection with any except the most refined means of measurement, may render the whole useless. The metallic alloy best adapted for the requirements of specula was first employed for this purpose by Sir Isaac Newton, and is similar to that used by the ancient Egyptians for mirrors. It con-

sists of copper and tin, to which Newton added a little arsenic, and sometimes silver or zinc; but Lord Rosse found that the two metals first named are better without the addition of any other. The volatile metals are objectionable. Silver makes the alloy too soft; nickel, though it whitens the yellow alloy of copper, makes the speculum alloy yellowish. Rosse was particular that the copper and tin should be combined in their atomic proportions (4 atoms of copper =126·8, to 1 of tin =59), and the purest metals should be selected; for the smaller specula it is even recommended that the copper be obtained by the electrotype process; this is hardly practicable for the large ones. The alloy is remarkable for its extreme brittleness and hardness. Large masses of it sometimes break from a slight blow or sudden change of temperature; and it is so hard that it cannot be wrought with tools of steel. It takes a most brilliant polish, which it has been known to retain with little tarnish, though exposed to the air for more than 16 years. A large speculum, however, ought always to be covered when not in use, and the air about it should be kept dry by means of an open box of quicklime. Great difficulties have been encountered in preventing the large specula from changing their form by their own weight, and those of 6 ft. diameter are made so thick, to give them the necessary stiffness (though supported when finished by the most ingenious appliances), that they are among the heaviest of bronze castings; and the preparation of the rough mass is among the most difficult of foundery operations. Rosse's six-foot speculum weighs 4 tons; one of 3 ft. 3¾ in. thick, weighs 13 cwt.; and one of 2 ft., 3¼ cwt. The alloy is prepared by melting the metals separately, and pouring the tin into the copper, stirring rapidly, and then, before the tin oxidizes, casting the alloy into ingots. It is tested when cold to ascertain its brilliancy, and more tin is added if necessary. The best mode of preparing the moulds has been arrived at from long experimental trials in the casting of the smaller specula. It was found that sand moulding would not answer for the surface of the disks, as the texture of the alloy near the outside was rendered somewhat spongy and crystalline; and though this was so slight as to be detected only by the microscope, it still seriously impaired the polished surface. The face of the disk at least must then be "chilled," as cast iron is chilled, by pouring it into metallic moulds to increase the density of its surface. But the ordinary temperature of the atmosphere was found to be too low for the moulds to receive this alloy, and they were consequently heated to about 212° to prevent too sudden cooling and consequent irregular contraction. For moderate-sized specula cast-iron moulds were used, necessarily open, or the casting would inevitably fly in pieces. They were made a little deeper than the speculum, with the bottom of the same convexity with this, and so supported that they could be instantly filled from the lowest point, and turned into a horizontal position when charged with the proper weight of the metal. The air and any foreign substance present are thus carried up to the surface, and separated from the alloy. But this was not sufficiently perfect for the largest castings, and Lord Rosse adopted for these the following method. An iron frame of sufficient diameter was filled with pieces of hoop iron set on edge and tightly wedged together, and the upper surface was turned off to the curvature of the face of the speculum. This was to serve for the bottom of the mould, being tight enough to hold the melted metal, while it allowed the escape of the gases through the interstices uniformly over the whole face. Upon this bottom was laid the wooden pattern, made twice as deep as the intended speculum, and with an allowance of $\frac{1}{65}$ in the diameter for shrinkage. The sides of the mould were then formed by ramming sand around the pattern. By this arrangement the first cooling is on the under face, next on the sides, and the final congealing is on the top or back, where the contraction and resulting irregularities will be concentrated in the least important part. The metal while red-hot is removed to a furnace specially prepared for it, the bottom having the curvature of the disk (unless in case of using an iron mould, when this too is taken along). By fires already kept up several days, the inner walls of the furnace should be at a full red heat. The vacant spaces around the casting are then filled with ignited fuel, and every aperture is carefully luted. A large speculum should thus be left to cool for a month to six weeks; and the result may still be unsatisfactory if the walls of the furnace are less than 2 ft. thick.—The production of the true parabolic figure, combined with a brilliant polish, is attained by grinding succeeded by polishing. Machines applicable to this object have been invented by Sir W. and Sir J. Herschel, Lord Rosse, Mr. Lassell, an amateur optician and astronomer, Mr. De la Rue, Mr. Grubb of Dublin, and others, which are too complicated to be particularly described in this place. The object sought for is to restrict the operation of the rubbing tools to the production of the particular curvature required, and insure a uniform action upon every part of the surface of the disk. The speculum, placed upon a slowly revolving platform, presents its face to the action of the rubber above it, which by Lord Rosse's arrangement was caused to vibrate regularly in one and the other direction, while at the same time it revolved at a different rate from that of the speculum. Mr. Lassell caused the rubber to revolve in small circles, while the speculum, turning on its axis, which was not in line with that of the rubber, presented successively all portions of its surface to this circling action of the rubber, thus imitating the movements of the hands by which the

small specula had previously been successfully polished. The principles of the arrangement of Mr. Lassell were so mathematically exact, that, as stated by Mr. Nasmyth, "a speculum having a decidedly hyperbolic figure may be corrected and brought to a perfect parabola, or to a spherical curve, or the same may be done in the reverse order at pleasure." The test of the polishing consists in observing through an eye piece the reflection of the dial of a watch set directly over the speculum, in the case of Lord Rosse's operations at the height of 90 ft. The success of the polishing was dependent on the state of the atmosphere as regards temperature and moisture, both of which required at times to be artificially regulated. The tools for first smoothing the face of the speculum are made up of pieces of gritstone, cemented together in a frame and dressed on the face to the proper degree of convexity. The next are disks of cast iron, their face also of the exact curvature, and grooved by two lines of furrows a quarter of an inch wide and the same deep, crossing each other at right angles. These are fed with sharp quartz sand, and afterward with emery and water. When the work has proceeded to the use of very fine emery the scratches disappear, and the rubber is in perfect and uniform contact with the speculum. For polishing, the cast-iron rubber was used by Lord Rosse, counterpoised and provided with circular grooves in addition to the rectilinear ones. Its face was coated with a thin layer of pitch, with another upon this of rosin and flour, which serves as the bed for the polishing powder or rouge to imbed itself. Mr. Lassell's polisher was of pine wood in two layers, the grain crossing, and the face coated with pitch above. The preparation of these polishers involves nice operations, which may not be neglected without great risk of failure. The largest specula when polished ought never to be removed from their supports; for however carefully lifted, the figure would be almost certain to lose its accuracy by change of pressure in the mass. Even one of 9 in. diameter, when supported by the pressure of springs against three stops bearing on its edges, loses its defining power. Sir John Herschel laid the speculum upon folds of woollen cloth, packing others closely all around it, filling the space between its edges and the box that contained it; but this is not sufficient to preserve the form of the specula of 6 ft. diameter and as many inches thick, and the contrivances for this are a most complicated system of bearings, springs, and levers.—Specula exhibit some peculiarities in their forms and applications to use, according to the kind of reflecting telescope for which they are designed. It is evident that as they reflect images as mirrors, the observer cannot be placed directly in front, and it is not obvious how he can take his position at the opposite end of the telescope, as in using those of the refractory kind. This is accomplished in the reflecting telescope of Dr. James Gregory, known as the Gregorian telescope, by an aperture through the centre of the speculum, and the introduction of a small concave speculum in the centre of the great tube, facing the large speculum, and a little in advance of its focus. Back of the great speculum the tube is extended of reduced diameter, and in its extremity is a magnifying eye piece, by which the image reflected from the small speculum through the aperture of the large one reaches the eye. In Sir William Herschel's great telescope, with its 4-ft. speculum and 40-ft. focal length, the disk was entire, and the image was reflected direct to an eye piece at the mouth of the tube and near one side of it, so as not to intercept too much light. This was effected by a slight inclination of the plane of the speculum. In Sir Isaac Newton's telescope the disk was also entire, and a small plain speculum reflected the cone of rays sent from it, before meeting in the focus, to the eye piece placed in the upper side of the tube. Cassegrain's telescope differs from Gregory's in the small reflector being convex instead of concave.—Specula have recently been made of polished silver surface, which has the advantage over that of the speculum metal of reflecting 91 per cent. of the incident light, instead of 67 per cent. The silver, after the method of M. Léon Foucault, is laid in a very thin uniform coating upon a speculum of glass, figured and polished to a true parabola. This is done by Drayton's process of precipitating the metal from the solution in nitric acid by oil of cassia. The precipitated silver is polished by gentle rubbing with a skin lightly tinged with oxide of iron, and soon acquires a very brilliant lustre without material change of figure. This, however, was questioned by Mr. Grubb, when the subject was under consideration before the British association at Dublin, who asserted from his own experience that the removal of a thickness of $\frac{1}{40,000}$ or $\frac{1}{50,000}$ of an inch might seriously impair the accuracy of the defining power of the speculum. M. Foucault had preserved the silver mirrors for eight months without their being injured by tarnishing; but whenever this might occur they were easily polished again, and the silver itself could be at any time renewed. Mr. Browning of London has carried to a high degree of perfection the construction of silvered-glass reflectors; and the experience of those acquainted with instruments constructed on his plan is strongly in favor of the method. In America the reflecting telescope has not hitherto met with much favor; though the success with which Dr. H. Draper of New York has constructed large reflecting telescopes, and employed them even in the delicate work of lunar photography, promises before long to enlist American ingenuity in the improvement of a class of telescopes which must probably always have the preference over refractors for observations requiring very great space-penetrating power.—The subject of the speculum, in its

mathematical and mechanical details, is treated in various memoirs in the English scientific journals, from the time of Newton's paper in the "Philosophical Transactions" of 1672 to the present day. Lord Rosse's papers are contained in the "Edinburgh Journal," vol. ix., 1828, and vol. ii. (new series), 1829, and in the "Philosophical Transactions," 1840 and 1850. The mechanical details are fully described in Holtzapffel's "Mechanical Manipulations." For Lassell's process, see "Transactions of the Royal Astronomical Society," 1849.

**SPEKE, John Hanning,** an English traveller, born in Somersetshire, May 4, 1827, died near Bath, Sept. 15, 1864. He served as a captain in the British army in the Punjaub under Lord Gough (1849), and subsequently made scientific explorations in the Himalaya. In 1854 he set out with Burton for the Somauli country, where they were attacked and Speke was wounded. He next enlisted in the Turkish army in the Crimea shortly before the close of the war. He gained a wide celebrity by his joint expedition with Burton (1856) to Africa, and the discovery of Lake Tanganyika. (See BURTON, RICHARD FRANCIS.) On July 30, 1858, he discovered alone the Victoria N'yanza lake, and in 1862 he explored its western and northern margin together with Capt. J. A. Grant. (See NILE, and N'YANZA.) Capt. Speke was killed by the accidental discharge of a gun while hunting. His principal work is his "Journal of the Discovery of the Source of the Nile" (2 vols., London, 1863).

**SPELMAN, Sir Henry,** an English antiquary, born at Congham, near Lynn, Norfolkshire, in 1562, died in London in 1641. He was educated at Cambridge, and devoted himself to historical and antiquarian studies. He served as sheriff of his county, and was knighted by James I. and appointed commissioner to determine disputed claims to lands and manors in Ireland. In 1612 he settled in London. He wrote *Glossarium Archaiologicum* (A to L, 1626; completed from his manuscripts, 1664; best ed., 1687); *Concilia, Decreta, Leges, Constitutiones, in Re Ecclesiastica Orbis Britannici* (2 vols., 1639-'64); and *Villare Anglicanum* (1656). The *Reliquiæ Spelmannianæ* (fol., Oxford, 1698) is a collection of his papers relating to the laws and antiquities of England.

**SPENCE, Joseph,** an English author, born at Kingsclerc, Hampshire, April 25, 1699, drowned at Byfleet, Surrey, Aug. 20, 1768. He was educated at Oxford, entered holy orders, and was elected professor of poetry. He published in 1726 "An Essay on Pope's Odyssey," and made a tour through France and Italy in 1730-'33. In 1731 he published a biography of Stephen Duck, afterward prefixed to an edition of Duck's poems, and in 1736 reproduced with a preface at Pope's request Sackville's tragedy of "Gorboduc." In 1742 he was presented by his college to the rectory of Great Horwood, and appointed professor of modern history at Oxford. His most interesting production is "Anecdotes, Observations, and Characters of Books and Men," collected from the conversation of Pope and others, and valuable with reference to the literary history of his time. It was published, with notes and a biography, by S. W. Singer (London, 1820; new ed., 1858).

**SPENCE, William,** an English entomologist, born in 1783, died in London, Jan. 6, 1860. In 1805, while engaged in business at Hull, he presented a few specimens of insects to the Rev. William Kirby, with whom he afterward wrote "Introduction to Entomology, or Elements of the Natural History of Insects" (4 vols., 1815-'26; 7th ed., 1 vol., 1858). It consists of 51 letters, of which 9 were written by Mr. Spence, 20 by Mr. Kirby, and 22 by them conjointly. He was for a time a member of parliament. He removed in 1826 to the continent, and visited the principal European capitals during the next eight years, returned to England and settled in London.

**SPENCER. I.** A N. county of Kentucky, intersected by Salt river; area, 280 sq. m.; pop. in 1870, 5,956, of whom 1,479 were colored. The surface is hilly and the soil fertile. The chief productions in 1870 were 105,211 bushels of wheat, 16,470 of rye, 436,875 of Indian corn, 35,885 of oats, 1,852 tons of hay, 5,500 lbs. of tobacco, 15,385 of wool, 119,748 of butter, and 8,488 gallons of sorghum molasses. There were 3,018 horses, 538 mules and asses, 1,935 milch cows, 3,252 other cattle, 4,530 sheep, and 17,724 swine; 6 flour mills, and 4 distilleries. Capital, Taylorsville. **II.** A S. W. county of Indiana, bordering on the Ohio river, bounded E. by Anderson's creek and W. by Little Pigeon creek; area, 390 sq. m.; pop. in 1870, 17,998. The surface is hilly in the W. part and level in the S., and the soil is fertile. Bituminous coal is abundant. The chief productions in 1870 were 123,663 bushels of wheat, 682,374 of Indian corn, 98,510 of oats, 79,597 of potatoes, 7,878 tons of hay, 3,019,970 lbs. of tobacco, 21,416 of wool, and 49,006 gallons of sorghum molasses. There were 4,892 horses, 683 mules and asses, 3,711 milch cows, 5,720 other cattle, 14,054 sheep, and 23,506 swine; 5 manufactories of carriages and wagons, 5 of furniture, 2 of tobacco and snuff, 10 flour mills, 6 saw mills, and 3 planing mills. Capital, Rockport.

**SPENCER. I. Ambrose,** an American jurist, born at Salisbury, Conn., Dec. 13, 1765, died at Lyons, N. Y., March 13, 1848. He graduated at Harvard college in 1783, studied law, and commenced practice in Hudson, N. Y. In 1793 he represented Columbia co. in the state legislature; in 1795 and for seven consecutive years he was a state senator; in 1802 he was appointed attorney general, in 1804 made a justice of the supreme court, and in 1819 chief justice. He was a member of the constitutional convention of 1821, and was the author of the law abolishing the punishment of death in all cases except treason and murder. He resigned the office of chief justice in 1823, and

resumed practice at Albany. He was for some years mayor of that city, and also represented the Albany district in congress. In 1839 he retired to Lyons. **II. John Canfield**, an American jurist, son of the preceding, born in Hudson, N. Y., Jan. 8, 1788, died in Albany, May 18, 1855. He graduated at Union college in 1806, and in 1807 became private secretary of Gov. Tompkins. He was admitted to the bar in Canandaigua in 1809, was master in chancery and district attorney, a member of congress 1817-'19, and several times of the state assembly and senate. In 1827 he was appointed one of the revisers of the statutes of the state, and in 1839 secretary of the state of New York. President Tyler in 1841 appointed him secretary of war, and in 1843 transferred him to the treasury department. He resigned in 1844, from opposition to the annexation of Texas. He served on many state commissions, and aided in the organization of the asylum for idiots and the improvement of the common school system. He edited De Tocqueville's "Democracy in America," with an original preface and notes (New York, 1838).

**SPENCER. I. George John**, second Earl Spencer, an English bibliophile, born Sept. 1, 1758, died Nov. 10, 1834. Under the courtesy title of Viscount Althorp, he was first lord of the admiralty from 1794 to 1801, and subsequently home secretary. On the death of his father in 1821 he took his seat in the house of lords. He possessed one of the largest and most remarkable private libraries in Europe, the nucleus of which he acquired in 1789 from the Hungarian baron Reviczky. See Dibdin's *Bibliotheca Spenceriana* (4 vols. 8vo, 1814-'15), and *Ædes Althorpianæ* (2 vols., 1822). **II. John Charles**, third Earl Spencer, an English statesman, son of the preceding, born May 30, 1782, died at Wiseton hall, Nottinghamshire, Oct. 1, 1845. He served in the house of commons as Viscount Althorp, during the whig administration of 1806-'7 was junior lord of the treasury, and afterward a leader of the whig opposition until the return of the whigs to power in 1830, when he was appointed chancellor of the exchequer, and became ministerial leader in the house of commons, through which he was instrumental in carrying the reform bill and the poor-law amendment bill. He resigned with his colleagues in November, 1834. About the same time he succeeded his father as Earl Spencer, and devoted himself to farming. He was the first president of the royal agricultural society.

**SPENCER, George** (Father Ignatius of St. Paul), an English clergyman, youngest son of John George, second Earl Spencer, born in London, Dec. 21, 1799, died at Carstairs, Scotland, Oct. 1, 1864. He graduated at Cambridge in 1819, took orders, and became rector of the family living of Brington in 1825. He joined the Roman Catholic church at Leicester in 1830, was ordained priest in 1832, and took charge of the missions of West Bromwich and Dudley. In 1839 he was appointed to an office in Oscott college, became soon afterward its rector, entered the order of Passionists in 1846, and contributed very much toward the extension of his order in Great Britain and Ireland, filling high offices therein till his death. He was chiefly distinguished for his extraordinary zeal in ministering to the spiritual wants of the laboring population, and for his efforts in establishing an association of prayers for the return of England to communion with the church of Rome. For this purpose, from 1838 till 1857, he repeatedly visited Ireland and the Roman Catholic countries on the continent, preaching and lecturing everywhere on this subject. He wrote "Account of my Conversion" (1831), an autobiography and journal embodied by Father Pius in his "Life of Father Ignatius of St. Paul, Passionist" (Dublin and London, 1866), and a "Life of St. Paul of the Cross" (London, 1875).

**SPENCER, Herbert**, an English philosopher, born in Derby, April 27, 1820. His father was a teacher. Herbert was fond of keeping insects and watching their transformations, and for years the finding and rearing of caterpillars, the catching and preserving of winged insects and making drawings of them, were his regular occupations. He also assisted his father in philosophical experiments. At the age of 13 he was sent to study with his uncle, the Rev. Thomas Spencer, rector of the parish of Hinton. Here he remained three years, and made special progress in mathematics. Returning home, he studied perspective with his father, on the principle of independent discovery, the successive problems being put in such order that he was enabled to find out the solutions himself. This was a favorite mode of teaching with his father, who is the author of a valuable little work entitled "Inventional Geometry," on this plan. At 16 Herbert devised a new and ingenious theorem in descriptive geometry, which was published with the demonstration in the "Civil Engineers' and Architects' Journal." At 17 he accepted an engagement under Charles (afterward Sir Charles) Fox as a civil engineer, and began work on the London and Birmingham railway. In 1841 he declined a further appointment, returned home, and spent two years in mathematical and miscellaneous studies. He made a botanical press and a herbarium, and practised drawing and modelling. All the time he had in progress some scheme of invention, improvements in watchmaking, machinery for the manufacture of type by compression of the metal instead of casting, a new form of printing press, and the application of electrotype to engraving, afterward known as the glyptograph. In the spring of 1843 he went to London in quest of literary occupation, but did not succeed, and resumed engineering. His earliest literary contributions were made to the "Civil Engineers' and Architects' Journal," the "Philosophical Magazine," the "Zoist," and the "Noncon-

formist." In the last named journal, in 1842, he began the publication of a series of papers on the "Proper Sphere of Government," which were issued in a pamphlet in 1843. From 1848 to 1852 he was a regular writer for the "Economist," and subsequently contributed to various reviews elaborate papers which were pervaded with the idea, since more distinctly developed, known as the doctrine of evolution. He soon became a firm believer that all organized beings have arisen by development. In 1854 he first conceived of evolution as a universal process, and later he came to the conclusion that it must become the basis of any system of philosophy which represents and conforms to the general method of nature. In 1860 he published a prospectus of such a system, and immediately entered upon its execution. He had already collected his essays upon the scientific aspects of social questions, and had published various volumes leading up to his system. Most of these were revised and enlarged in subsequent editions to present more fully his new philosophy. The fourth division of his system, devoted to sociology, deals with the science of human society from the point of view of evolution expounded and applied to the general phenomena of life and mind in his earlier volumes. In furtherance of this department of his work, he has for several years employed the aid of three assistants in collecting and classifying facts pertaining to all types of society, savage tribes, decayed races, and existing civilizations, which, under the title of "Descriptive Sociology," are intended to form a series of folio volumes, of which three have been published (1876). The following is a complete list of his publications: "Social Statics, or the Conditions essential to Human Happiness specified, and the first of them developed" (London, 1850; New York, 1865); "Principles of Psychology" (London, 1855; revised ed., 2 vols., London and New York, 1870–'72); "Railway Morals and Railway Policy" (London, 1855); "Essays, Scientific, Political, and Speculative" (London, 1857; 2d series, 1863; American ed., "Illustrations of Universal Progress," New York, 1864); "Essays, Moral, Political, and Æsthetic" (New York, 1865; new and enlarged ed., 1874); "Education, Intellectual, Moral, and Physical" (London and New York, 1860); "First Principles of a System of Philosophy" (London, 1862; New York, 1864); "Classification of the Sciences," to which is added "Reasons for dissenting from the Philosophy of M. Comte" (London, 1864; 3d ed., 1871); "Principles of Biology" (2 vols., London, 1864; New York, 1866–'7); "Spontaneous Generation, and the Hypothesis of Physiological Units" (New York, 1870); "Recent Discussions in Science, Philosophy, and Morals," collected from English reviews (New York, 1871; 2d ed., with six additional articles, 1873); "The Study of Sociology" (London and New York, 1873); "Descriptive Sociology: Facts Classified and Arranged" (3 vols. fol., London and New York, 1873–'4); and "The Principles of Sociology," a quarterly serial (London and New York, 1874 *et seq.*). In the system of philosophy series, apart from their publication as separate volumes, "First Principles," "Principles of Biology," and "Principles of Psychology" have been issued in London serially in 34 numbers; so that the sociological division begins with No. 35 under the title "The Principles of Sociology." Nos. 35–38 were published in London and New York in 1874–'5, and the whole work is expected to consist of 15 or 18 parts.

**SPENCER, Ichabod Smith**, an American clergyman, born at Rupert, Vt., Feb. 23, 1798, died in Brooklyn, N. Y., Nov. 23, 1854. He graduated at Union college in 1822, and was principal of the grammar school in Schenectady till 1825, and afterward till 1828 of an academy in Canandaigua, N. Y. He was licensed to preach by the presbytery of Geneva in 1826, and in 1828 was settled as colleague pastor of the Congregational church in Northampton, Mass. From 1832 till his death he was pastor of the second Presbyterian church in Brooklyn; and from 1836 to 1840 extraordinary professor of Biblical history in Union theological seminary, New York, of which he was one of the founders. His best known publication is his "Pastor's Sketches" (two series, New York, 1850–'53), which has passed through many editions, and been translated into French. Since his death there have been published from his manuscripts "Sermons," with a memoir by J. M. Sherwood (2 vols., New York, 1855); "Sacramental Discourses" (1861); and "Evidences of Divine Revelation" (Boston, 1865).

**SPENCER, Jesse Ames**, an American clergyman, born at Hyde Park, Dutchess co., N. Y., June 17, 1816. He graduated at Columbia college in 1837 (from which he received the degree of S. T. D. in 1852), studied theology in the general seminary of the Episcopal church, became rector of St. James's church, Goshen, N. Y., in 1840, and afterward engaged in teaching, and travelled in Europe and the East. In 1849 he was appointed professor of Latin and oriental languages in Burlington college, N. J., and from 1851 to 1857 was editor and secretary of the Episcopal Sunday school union and church book society. In 1863–'5 he was rector of St. Paul's church, Flatbush, L. I., and in 1869 became professor of Greek in the college of the city of New York. He has published "Discourses" (1843); "The New Testament in Greek, with Notes on the Historical Books" (1847); "Cæsar's Commentaries," with notes, lexicon, &c. (1848); "Egypt and the Holy Land" (1849); "History of the United States" (4 vols. 8vo, 1856–'69); "Greek Praxis" (1870); "The Young Ruler and other Discourses" (1871); and "A Course of English Reading" (1873). He has also edited Archbishop Trench's poems (1856), and Xenophon's Anabasis from the manuscripts of Prof. A. Crosby (1875).

**SPENER, Philipp Jakob,** a German theologian, born at Rappoltsweiler, Alsace, in January, 1635, died in Berlin, Feb. 5, 1705. He studied at Strasburg, early lectured on philosophy and history, and was tutor to several of the princes palatine. After attending Swiss and French universities, he began in 1663 to preach at Strasburg. In 1664 he was made doctor of theology, and in 1666 chief of the clergy at Frankfort. While the orthodox Lutherans based their theology on the Bible as explained by the symbolical books, he based it on the Bible as confirmed and explained by personal experiences. He instituted at Frankfort classes for catechizing the young, and his prayer meetings (*collegia pietatis*) and conventicles (*ecclesiolæ in ecclesia*) created a popular and strictly Biblical theology. From his *collegia* sprang the sect of the pietists, so called at first in derision, but finally the name was accepted by themselves. In 1686 he removed to Dresden, where he was appointed chief court preacher and a member of the consistory. His views were violently opposed by the Saxon clergy, especially after the foundation of the new university at Halle, the professorships in which were filled by his disciples, and which became at once the central point of the pietistic doctrines. The faculty of Wittenberg designated in his writings about 300 false doctrines, although he fully adhered to the confession of Augsburg. He defended himself with ability and success; but in 1691 he gladly accepted an invitation from the elector Frederick of Brandenburg to reside at Berlin, as provost, inspector of the church of St. Nicholas, and assessor of the consistory. He wrote *Pia Desideria* (1675; new ed. by Feldner, Dresden, 1846), and other theological as well as genealogical works.—See Hossbach, *Philipp Jakob Spener und seine Zeit* (2 vols., Berlin, 1828; 3d ed. by Schweder, 1861), and Thilo, *Spener als Katechet* (Stuttgart, 1841).

**SPENSER, Edmund,** an English poet, born in East Smithfield, London, probably in 1553, died in King street, Westminster, Jan. 16, 1599. In one of his poems he alludes to his connection with "an house of ancient fame," and it is maintained by Mr. Craik that he belonged to the Spencers of Hurstwood, Lancashire. He was entered a sizar of Pembroke hall, Cambridge, in 1569, and took the degree of bachelor in 1572 and of master in 1576. He there formed a life-long intimacy with Gabriel Harvey, the poet and astrologer. On leaving the university he visited the north of England, where he wrote his "Shephearde's Calendar." Induced by Harvey to go to London, he was introduced to Sir Philip Sidney, who invited him to become his guest, and to whom, in return for his hospitality, he dedicated his "Shephearde's Calendar" (1579). For the next ten years little is known concerning Spenser. He corresponded with Harvey on the innovation of banishing rhymes and introducing the Latin prosody into English verse. Recommended by Sidney to his uncle, the powerful earl of Leicester, he was occasionally employed in small missions, and in 1580 was sent to Ireland as secretary to Lord Grey de Wilton, who was appointed lord deputy of that country. The "Foure Epistles," on satiric poetry and on an earthquake in London, which passed between Spenser and Harvey, and which induced a controversy between the latter and Nash, were published the same year. He returned in 1582, and in 1586 obtained a grant of 3,028 acres of the forfeited lands of the earl of Desmond, in the county of Cork, on condition that he should reside on his estate; and he therefore took up his abode in Kilcolman castle, near Doneraile, where he composed most of the "Faerie Queen," upon which he had been engaged several years. After the death of Sidney, he wrote the pastoral elegy of "Astrophel" to his memory. Raleigh now became his principal patron and friend, and in 1589 persuaded him to return to London to arrange for the publication of his poem. The first three books appeared in 1590, dedicated to Queen Elizabeth, with a letter to Raleigh explaining the work as "a continued allegory or dark conceit." He was presented to the queen, from whom he received a pension of £50, returned to Ireland, and published "Colin Clout's come Home again" (1591); a collection of minor poems entitled "Complaints" (1591); a series of "Amoretti" and the "Epithalamium" (1595), relating to his courtship and marriage; four "Hymns" (1596), the two on love and duty, pervaded by a Platonic doctrine, being among his most exquisite productions; and the fourth, fifth, and sixth books of the "Faerie Queen" (1596). He was married in 1594, but it is not certain whether the lady was the "Elizabeth" of his sonnets, nor whether it was a first or second marriage. In 1596 he presented to the queen his "View of the State of Ireland," a treatise in the form of a dialogue, not published till 1633. He was a conspicuous object for the enmity of the Irish on the outbreak of Tyrone's rebellion, since he was clerk of the council of Munster, and had been nominated sheriff of Cork. When the insurgents rose in Munster in 1598, they attacked Kilcolman, and the poet fled with his wife. The castle was plundered and burned, and an infant child, which had been left behind, perished in the flames. Spenser died at an inn a few months after his arrival in London, it is said for want of bread; but there are circumstances which make this account doubtful. He was buried at the expense of the earl of Essex, and at his own request near the remains of Chaucer, in Westminster abbey. A monument erected to him after 30 years by Anne, countess of Dorset, was restored in 1778 by the fellows of Pembroke hall.—His chief poem, the "Faerie Queen," is unfinished. The Spenserian stanza, in which it is written, is a modification of the Italian *ottava rima*, with the addition of the

Alexandrine line, and the diction was purposely studded with forms and phrases which had become antiquated. Yet Spenser is scarcely surpassed as a master of musical language. The leading story is an allegory, founded on the traditional history of Prince Arthur, who was taken as the ideal of a noble person. Gloriana, the queen of Faerie, who gave name to the poem, is an emblem of virtuous renown. All the personages are symbolical and all the incidents significant of moral truths. The subject of each book is a moral attribute, as holiness, temperance, chastity, friendship, justice, and courtesy, personified by a knight errant, with all human passions. The last great poem of chivalry, it was received with enthusiasm in the adventurous age of Elizabeth. The first canto is much the finest; the allegory in it is so skilfully disguised that it may be disregarded; and it fully exhibits the freshness and power of his genius. An edition of his poems by G. S. Hillard, with a critical introduction, was published in Boston in 1839 (5 vols.). They also form five volumes (1855) in the Boston collection of "British Poets." A variorum edition was published by the Rev. Henry John Todd (8 vols. 8vo, London, 1805). An edition, with glossary, notes, and life, by J. P. Collier (5 vols. 8vo, London, 1862), is probably the most accurate and complete.

**SPERANSKI, Mikhail,** a Russian statesman, born in the government of Vladimir, Jan. 1, 1772, died in St. Petersburg, Feb. 23, 1839. In 1797 he was appointed professor of mathematics at St. Petersburg, in 1801 secretary to the council of the empire, in 1802 was charged with the organization of the ministry of the interior, and in 1808 became assistant minister of justice. He improved the finances, remodelled the method of taxation, increased the educational funds, introduced a new penal code, and reorganized the commission for codifying the laws. In March, 1812, he was forced to resign, and was banished to Nizhni-Novgorod; but in 1816 he was restored to favor, and in 1817 appointed governor of Penza, and in 1819 of Siberia. On the accession of Nicholas in 1825, he was appointed president of the chancery, and resumed the work of codifying the laws. He published all the laws and edicts from 1694 in 45 vols. 4to, and an abridgment in 15 vols. 8vo.

**SPERMACETI** (Gr. *σπέρμα*, sperm, and *κῆτος*, a whale), a solid crystalline fat, extracted from the oily fluids found in a triangular cavity by the right side of the nose and in the upper part of the head of the sperm whale or blunt-headed cachalot, and also in smaller quantities in some other species of the cetacea. The liquid contents boiled out from the head of the sperm whale of ordinary size sometimes amount to more than 12 large barrels full. When cold they concrete into a spongy mass, from which the larger portion of the oil drains away, leaving the crude spermaceti. This filtration is made more effective by compression in bags in a hydraulic press; and the subsequent purification is effected by melting the residue in water and skimming off the impurities, and remelting in a weak potash lye, which removes nearly all traces of the oil. The spermaceti is then melted alone by steam heat, and ladled into pans, where it cools in white, semi-transparent, lamellar cakes. The last traces of oil may be removed by boiling once or more with alcohol, which dissolves the spermaceti, but when cold holds only the oil. Pure spermaceti, called cetine, has a foliaceous texture and a delicate whiteness. It is semi-transparent, friable, unctuous to the touch, and resembles white wax in lustre and hardness. It is without taste and of hardly any odor; of specific gravity ·940; melts at 120°; dissolves readily in hot ether, and in the fatty and volatile oils, separating on cooling. At high temperatures it sublimes without decomposition if protected from the air. By the addition of a few drops of alcohol or of almond oil it may be powdered. Its ready inflammability in connection with its fusibility renders it well adapted for candles, which is the chief use made of it. (See CANDLE.) It has been employed in medicine, combined with sirup or mucilage, to protect the throat in coughs and colds; and triturated with sugar candy with the addition of milk, it forms a simple nutritive mixture. In pharmacy its use is of greater importance as an ingredient in ointments and cerates. It is not readily saponified, and in this change it differs from the other fats in not yielding glycerine, but another base instead, termed ethal, a white, solid substance, fusible at 118°, and possessing the properties of a true alcohol. It is also called cetylic or ethalic alcohol, and is represented by the formula $C_{16}H_{34}O$. The acid, into which also the spermaceti is resolved, is known as the cetylic, ethalic, or palmitic acid, and is represented by the formula $C_{16}H_{32}O_2$.

**SPERMOPHILE.** See PRAIRIE SQUIRREL.

**SPERM WHALE.** See WHALE.

**SPEUSIPPUS,** a Greek philosopher, born in Athens about 380 B. C., died in 339. He was a nephew of Plato, and at his death succeeded him as president of the academy, over which he presided eight years (347–339). He followed partially the philosophic system of his master, but diverged from it in the prominence he gave to empiricism. He adopted Plato's threefold division of philosophy into dialectics, ethics, and physics.

**SPEYER,** or **Speyr.** See SPIRE.

**SPEZIA, La,** a town of N. Italy, in the province and 50 m. S. E. of the city of Genoa; pop. in 1872, 24,123. It is at the N. W. extremity of the gulf of Spezia (anc. *Portus Lunæ*), which is one of the largest and finest harbors in the world, surrounded by lofty mountains and containing within itself many minor ports. Spezia contains the principal naval arsenal of Italy, and is an important station for foreign squadrons. The arrivals and departures of steamers

in 1872, including the ports of Lerici, Fezzano, and Portovenere within the gulf of Spezia, amounted to 461 and 459, and of sailing vessels to 1,118 and 1,124; aggregate tonnage, 93,445. The imports were valued at $1,607,000 (including $867,660 for the navy) and the exports at $533,772. Among the most celebrated products are olive oil and wine.

**SPEZZIA,** or **Spetzia** (anc. *Tiparenos*), an island of Greece, in the archipelago, at the E. entrance of the gulf of Nauplia, and about 2 m. from the coast of Argolis; greatest length 5 m., greatest breadth 3 m.; pop. in 1870, 8,443. It is rocky, but has some fertile patches, which are carefully cultivated. In the war of independence the islanders distinguished themselves in naval engagements with the Turks. The chief place, of the same name, is a pleasant town on the E. shore, with a good harbor; pop. about 3,000. It is a resort for invalids on account of the climate.

**SPHAGNUM.** See MOSSES.

**SPHENOGRAMS.** See CUNEIFORM INSCRIPTIONS.

**SPHERE** (Gr. σφαῖρα), in geometry, a body bounded by a surface, every point of which is equally distant from a point within called the centre. The figure may be generated by the revolution of a semicircle about its diameter as an axis. It is easily shown that if a sphere be enclosed in a right cylinder, the portions of the surface between any pair of planes parallel to the bases of the cylinder are equal in area to the portions of the cylindrical surface between the same planes. Accordingly, the total surface of the sphere is equal to the curved surface of the cylinder. This surface is manifestly equal to the rectangle of the height of the cylinder by the circumference of its base; that is, to four times the base, for the height of the cylinder is equal to the diameter of the base. Hence the surface of a sphere is equal to four times the area of a circle of the same diameter. Its solid content is manifestly equal to that of a pyramid, whose base is equal to the surface of the sphere, and whose altitude is the radius; hence equal to one third of the product of its radius into its surface; or, the cube of the diameter being to the solid content nearly as 300 to 157, the content may be calculated from this proportion, or by multiplying the cube by the decimal ·52333.—In geography, sphere denotes a representation of the earth on a globular surface. (See GLOBE.) In astronomy, it is the concave expanse of the heavens, which appears as the interior surface of a sphere, of which the centre is the earth.

**SPHINX,** a fabulous monster of Greek mythology, which was represented generally as having the winged body of a lion and the breast and head of a woman, but sometimes with a female face, the breast, feet, and claws of a lion, the tail of a serpent, and the wings of a bird; and sometimes the fore part of the body is that of a lion, and the lower part that of a man, with the claws of a vulture and the wings of an eagle; all which forms were used as architectural ornaments. In the legends of the poets the sphinx is said to have been the daughter of Orthus and Chimæra, or of Typhon and Chimæra, or of Typhon and Echidna, and to have come from the most distant parts of Ethiopia. She is also said to have been sent by Mars to avenge the death of his son the dragon slain by Cadmus, or according to others sent by Bacchus or by Pluto; while others again represent her as one of the women who with the daughters of Cadmus were thrown into madness and metamorphosed into monsters. She was ravaging Thebes and devouring those who could not solve a riddle which she proposed to all whom she met, when Œdipus, being offered the crown of Thebes on condition of delivering the country from the monster, solved the riddle, upon which the sphinx destroyed herself. (See ŒDIPUS.)—It is probable that the Greeks derived the idea of the sphinx from Egypt, where from remote antiquity such figures had been used to embellish the avenues which formed the approaches to temples. Among the Egyptians they had the head of a man, bearded and capped, and the body of a lion, thus differing from the Greek sphinxes, which had a female head and the body of a winged lion. Clemens and Plutarch say they were placed before the temples as types of the mysterious nature of the deity. Some sphinxes have the head of a ram, and are called crio-sphinxes, and others the head of a hawk, called hieraco-sphinxes; the former were sacred to Amen or Jupiter Ammon, the latter to Ra, the god of the sun. The great sphinx at the pyramids was supposed by Lepsius to represent King Cephren, the builder of the second pyramid; but an inscription has lately been discovered which renders it probable that it was sculptured even before the time of Cheops, the builder of the first pyramid. The Egyptians called it Hor-em-khu, or Har-ma-khu, "the setting sun," the name of the god to whom it was dedicated, which was converted by the Greeks into Armachis. It is near the eastern edge of the platform on which the pyramids stand, with its head turned toward the Nile. The head measures 28 ft. 6 in. from the top to the chin. The total length of the body, which is that of a lion crouching close to the ground, is 146 ft. Across the shoulders it measures 36 ft., and the paws are extended about 50 ft. Between the paws was built a small temple, which was of masonry, as were the paws, while all the rest of the sphinx seems to be carved out of solid rock. Col. Vyse drilled a hole 27 ft. deep into one of the shoulders, and found that it was one piece of stone throughout. Near the sphinx Mariette discovered a vast temple buried in the sand, which is supposed to have been dedicated to the worship of the divinity of the sphinx. The countenance is now so much mutilated that the outline of the fea-

tures can with difficulty be traced. The head had been covered with a cap, the lower part of which remains, and it had originally a beard, the fragments of which were found below.

The Great Sphinx.

Immediately under the breast stood a granite tablet, and another of limestone on either side resting against the paws. The first contains a representation of Thothmes IV. offering incense and making libation to the sphinx, with a long inscription in hieroglyphics reciting the titles of the king. On the paws are inscriptions of the Roman times, expressive of adoration to the sphinx or to the Egyptian deities.

**SPHINX**, one of the names of the Guinea baboon (*cynocephalus papio*, Desm.). It is rarely seen in menageries, though it is remarkably intelligent; it is probably one of the species represented on the Egyptian monuments. It was known to Pliny. (See Baboon.)

**SPHINX CATERPILLAR.** See Hawk Moth.

**SPHYGMOGRAPH.** See Pulse.

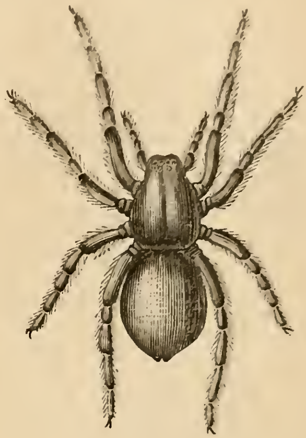
**SPICE ISLANDS.** See Moluccas.

**SPICEWOOD.** See Fever Bush.

**SPIDER**, a division of the insect order *arachnida*, which also includes the mites and scorpions. The general character of the order, which seems intermediate between crustaceans and insects proper, though nearest to the latter in mode of development, are given in the article. Arachnida. The external envelope is usually soft and tough, but not corneous, and is provided with papillæ, spines, bristles, and hairs, giving a furry or velvety, but generally disgusting aspect; the inner membrane of the skin is thin and colorless, and under it is a layer of colored vesicles and granules, the seat of the brilliant hues observed in many species. The body is divided into thorax and abdomen, the head is continuous with the chest, and there are no wings. From the inner surface of the cephalothorax are given off various processes serving for muscular insertions, forming at the bottom a solid horizontal plate, a kind of internal skeleton attached to the sternal plates by ligaments. The muscles are dirty yellow, transversely striated, and in general disposition like those of crustaceans; the principal masses are found in the cephalothorax, acting on the mouth, tactile organs, and legs; in those with an unarticulated abdomen there are numerous interlacing fibres encompassing this part, and sending processes among the organs and to the ventral tendinous ligament. The locomotive organs on the cephalothorax are four pairs of legs, of which the first in some resembles a posterior pair of metamorphosed jaws; each foot usually ends in two claws, but some have only one, and others three or four; each leg has usually seven joints; in some the tarsi have a great number of joints, which can be readily dropped off for the purpose of escape, and are reproduced at the time of the moult. The central part of the nervous system is situated around the œsophagus, sending nerves to the head and limbs; the splanchnic nerves for the viscera are well developed. The antennæ are transformed into the prehensile and masticatory mandibles; a delicate sense of touch resides in the palpi, and in the end of the feet, which are employed in constructing the web; the senses of taste, smell, and hearing have not been satisfactorily localized in any special organs. The eyes are smooth and simple stemmata, variously placed on the cephalothorax according to the mode of life of the species, usually eight, sometimes six, of different sizes, grouped symmetrically on the anterior median line or scattered on its lateral border, and directed accordingly upward or laterally; the diurnal species have the pigment greenish, reddish, or dark, and the nocturnal splendidly lustrous, as in the cats. The cheliceres or fangs have the form of biarticulated antennæ, the basal joint being very thick, and the terminal one a very sharp hook folded under the former when not in use, but capable of erection for defence or seizing prey, and having at the apex the opening of the duct of a poison gland; the first pair of maxillæ are changed into very long tactile or prehensile organs, the upwardly directed prominences of whose basal joints cover the entrance of the mouth, and serve as bruising organs; there is also a tumid hairy upper lip; the borders of the oral cavity may be approximated so as to form a suctorial canal, as well as the very short and horny œsophagus. The stomach is in the cephalothorax, and is divided behind the sucking apparatus into lateral halves extending in an arched manner in front, where they become contiguous or united into a ring, from which are given off four or five pairs of cæca directed toward the insertion of

the legs and palpi; the intestine arises from this annular stomach, traverses the abdomen on the median line, and before ending at the anus forms a cloacal dilatation; salivary glands exist in a cavity above the palate, communicating with the mouth by a slit in the upper lip; the liver is very large, enveloping most of the viscera, of a dirty yellow, made up of numerous branches and closely aggregated cæca, opening into the middle portion of the intestine. The blood is colorless; there is a heart, dorsal vessel with many constrictions, arteries, and vessels returning the blood from the respiratory organs. Respiration takes place both by pulmonary sacs and tracheæ, one or the other penetrating all parts of the body and limbs; there are two sacs occupying the base of the abdomen, containing more or less lamellæ; the blood penetrates to the respiratory system probably by a kind of infiltration. Distinct urinary organs are present, much ramified glandular tubes pouring a whitish or reddish secretion into the cloaca. There are two poison glands at the base of the chelicerес, communicating with their terminal hook. The apparatus which secretes the viscid transparent liquid, hardening into silk on exposure to the air, consists of glandular follicles and tubes, of various forms and arrangement, in the midst of the abdominal organs; in most spiders there are three pairs (in some two) of jointed spinnerets or obtusely conical papillæ behind the anus; the apex of these papillæ is surrounded by stiff bristles and hairs, and is dotted with numerous horny tubes, the prolongation of the excretory ducts; the number of the tubes varies from 1,000 in *epeïra* to less than 100 in the smaller species. The sexes are separate, and the eggs are numerous and spheroidal; a single impregnation is sufficient for several successive generations. There is generally only one brood in a year; the embryos are developed after the deposition of the eggs, and are hatched sometimes in a few weeks, and at others not till the following spring; the eggs are enveloped in a silken bag, from which the young are sometimes helped out by the mother; they resemble the parents except in size, and undergo no metamorphosis but change of skin; life may be prolonged for several years. Only the system of classification of Walckenaer will be briefly given here, as it places stress on the most interesting points in their economy, though not affording a sufficient basis for natural classification. He divides the spinning spiders into terrestrial and aquatic, as follows: I. *Venantes*, always running or leaping near their abode in search of prey, with the families: 1, *latebricolæ*, hiding in holes and fissures, like *mygale;* 2, *tubicolæ*, enclosing themselves in silken tubes (*dysdera*, *segestria*); 3, *cellulicolæ*, living in small cells (*scytodes*); 4, *cursores*, swift runners (*lycosa*, *ctenus*); 5, *saltatores*, leaping with agility (*attus*). II. *Vagantes*, wandering after prey, without fixed residence except while laying eggs, with family 6, *laterigradæ*, walking and running sideways or backward, and occasionally throwing out threads to entrap their prey (*thomisus*). III. *Errantes*, prowling in the neighborhood of their nests or threads, with families: 7, *niditelæ*, going abroad, but making a web whence issue threads to entrap prey (*clubiona*, *drassus*); 8, *filitelæ*, spreading long threads about their prowling places (*pholcus*, *clotho*). IV. *Sedentes*, spinning large webs and lying in wait in the middle or at the side, with families: 9, *tapitelæ*, spinning large webs of close texture in which they dwell (*tegenaria*, *agelena*); 10, *orbitelæ*, spreading orbicular or spiral webs of a regular open texture, living in the middle or at the side (*epeïra*); 11, *retitelæ*, spinning irregular webs of open meshes, remaining in the middle or on the side (*theridion*). V. *Natantes*, swimmers, spreading filaments in water, with family: 12, *aquitelæ* (*argyroneta*). —Spiders are found in every habitable portion of the globe, but are largest in warm climates; the males and females live separately, and the latter are most frequently seen and are considerably the larger; all are carnivorous, devouring living prey, sucking the juices and sometimes swallowing the fragments; the females are generally ready to attack and feed on the males, even in the reproducing season, and both sexes are fond of fighting, the vanquished being devoured; they can support long fasts, and remain torpid during the winter; they are very cleanly, and spend much time in clearing their limbs from dust and dirt by the toothed combs and brushes on the mandibles. In making their webs they accommodate themselves remarkably to circumstances, displaying great perseverance, ingenuity, and almost intelligence; they carefully guard their eggs, sometimes carrying about with them the silken bag which contains them, and are affectionate to their young, which in some cases devour their mother. They descend by their silken threads head downward, but climb up on them head upward, rolling them into a bundle during the ascent; the thread cannot be used a second time for the same purpose. When they wish to go from tree to tree, some let go a thread in the direction of the wind, and when it has reached the object they strengthen and pass over it, in this way travelling long distances without descending to the ground; their tiny cables are very abundantly seen in dewy mornings of spring and autumn; some small gossamer spiders even speed through the air buoyed up by their light threads. They are capable of some domestication; Pelisson, a prisoner in the Bastile, had a pet spider which came regularly, at the sound of a musical instrument, to get its meal of flies; and a spider raiser in France is said to have tamed 800, which he kept in a single apartment for their silk. The supply of the silk of the spider seems to be limited to sufficient to make six or seven webs in a season; it is very strong and very fine, and is used in astronomy for the divisions of the micrometer; ac-

cording to Leeuwenhoek, it takes 4,000,000 of the extremely delicate threads from the thousands of spinnerules to make a filament as large as a human hair; each thread of the spider as used in the web is made up of thousands of smaller ones; one or all the spinnerets may be used as occasion requires. Attempts have been made to render the silk of the spider available for manufacturing purposes, but with little success. (See COBWEB, and SILK SPIDER.) Spiders are eaten by many barbarous tribes of men, as the American Indians, S. Africans, and Australians; they also supply abundant food to many birds, reptiles, and carnivorous insects. They are affected and frequently destroyed by parasitic mites, and their eggs serve to nourish the young larvæ of several species of ichneumon flies; the smallest puncture in the chest or abdomen is fatal from the impossibility of arresting the escape of the nutrient fluids; their colors fade rapidly after death, even in preservative liquids. A single wound from a spider will soon kill the domestic fly; the large crab spiders of South America (*mygale*) leap upon and destroy humming birds and creepers, and produce dangerous and occasionally fatal symptoms in debilitated persons; every physician knows that even the bite of the smaller spiders of temperate climates may pierce the skin in certain localities, and cause painful irritation.—For descriptions and figures of the species of the United States see papers by N. M. Hentz in vols. iv., v., and vi. of the "Boston Journal of Natural History" (1841–'57), now in course of republication, with figures by the same society (1875). The genus *mygale* (Walck.) contains the largest of the spiders, of dark colors, nocturnal, living in galleries which they make in the ground, in clefts of trees, crevices in rocks, or among leaves. The crab or bird spider of South America (*M. avicularia*, Walck.) is about 3 in. long, its legs extending over a space of 8 or 10 in.; the body is very hairy and blackish, and the ends of the feet are reddish; it is very powerful, jumping upon and killing small birds; it spins no web; its cell is in the form of a pointed tube, of a white firm tissue. There are some large species in the southern states, feeding principally on the large orthoptera, believed by the Indians to possess valuable medicinal properties, and eaten accordingly. A large species (*M. Hentzii*) in Texas is called there tarantula; other species in California are called trap-door spiders, from their hollowing a more or less conical nest, about 3 in. long and an inch in diameter, in the clayey soil; the nests are lined with silk, with an accurately fitting lid, so arranged that the inmate can firmly hold it down against ordinary enemies; the cover outside so nearly resembles the surrounding earth in color and roughness as to be recognized with difficulty. For an account of the curious devices in the interior arrangement of these nests, see "Proceedings of the Boston Society of Natural History" for 1875. The species of the genus *lycosa* (Latr.) are well called wolf spiders, for they are the most savage, voracious, and quarrelsome of the family; they make no web, but prowl on the ground by night, running very fast, and hiding in nat-

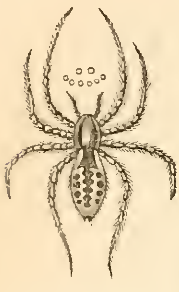


Wolf Spider (Lycosa fatifera).

ural or artificial holes in the ground, which they strengthen with silk; the females carry the cocoon attached to the posterior part of the body, and defend it with the greatest courage, some guarding it under stones; the young when hatched climb on the abdomen of the mother, giving her a monstrous appearance, and are said finally to devour her. One of the largest and most common species is the *L. fatifera* (Hentz), about $1\frac{1}{2}$ in. long, hairy, and bluish black; it is as large as the tarantula of Europe, which belongs to this genus, and is not uncommon in Massachusetts; it must rarely bite persons, from its habits and haunts, though its poison may produce ill consequences if introduced under the skin, not however to be compared with those from the *mygale* of the tropics; it is very savage and tenacious of life. The genus *attus* (Walck.) includes the small species commonly called jumping spiders; they make no web, wander in search of prey, and cast the skin and hibernate in silken-valved recesses; they are common in summer on walls and windows in the sun, walking by jerks, crawling stealthily up to flies, and jumping with rarely failing accuracy when near enough. The best known jumping spider in New England is the *A. familiaris* (Hentz), about $\frac{1}{2}$ in. long, pale gray and hairy, the abdomen blackish with a grayish angular band; it is very common in houses, dwelling in cracks on the outside, and wandering about in the sun in search of food; before leaping at a fly, it fixes a thread to secure itself from falling. It is widely dis-

Jumping Spider (Attus familiaris).

tributed. Its backward gait is as rapid as its forward. The long-legged spider (*pholcus Atlanticus*, Hentz) is about $\frac{1}{3}$ in. long, with a narrow body and very long slender legs, which are easily separated at the will of the animal when seized by them; the color is pale gray; it is common in corners of dark and rarely used rooms, in cellars and churches, spinning a very loose web crossed in all directions, which is very rapidly shaken when touched; the eggs are carried in the jaws, enveloped in a silken bag, and about 200 young are rolled in a ball not larger than a pea; the food consists of very small insects, though they eagerly devour each other, especially when young; they are favorite food for wasps, who store their cells with them as a provision for their young. The European representative is the *P. phalangioides* (Walck.). The common house spider (*tegenaria medicinalis*, Hentz) is found in every house and cellar in the land; the cheliceres are moderate, and the fourth pair of feet the longest; the upper two spinnerets are remarkably larger than the others, and the four anterior eyes in a line curved backward. It is sedentary, making in an obscure corner a large and nearly horizontal web, with a tubular habitation at the upper part; it is not quite an inch long, varying in color from pale brown to bluish black according to the absence of light in its retreat, with a dark band on each side of the thorax, and the abdomen and feet varied with blackish; the specific name is derived from the use formerly made of the web in cases of fever. In *epeïra* (Walck.) the web is either vertical or inclined, and the threads are arranged in a more or less regularly geometrical manner, radiating from the centre, where the animal remains, according to the absence of disturbing causes. The common epeïra (*E. vulgaris*, Hentz) is less than an inch long, with a full body, gray with blackish abdomen, with winding white marks and a white cross in the middle; it may almost be said to be domesticated, its geometrical web being so often met with near the windows of houses. The webs of the spider, like the cells of the bee, are not geometrically perfect; their irregularity can generally be detected even by the unassisted eye.—The long-legged, round-bodied spider, commonly called "father long-legs," is one of the trachearian arachnids, so named from the respiratory organs being radiated tracheæ, receiving air through two stigmatic openings; it is the harvest spider (*phalangium cornutum*, Linn.) in Europe, and an allied species in the United States. The eyes are two; the mandibles end in double pincers; the legs are eight, slender, and when separated from the body exhibit signs of irritability for some time. They are harmless, preying upon mites and small insects, and are very common in the fields.—Many small spiders fly about on their silken threads, carried far by currents of wind.—Of the *arachnida*, the scorpions appeared first in the carboniferous epoch, and the true spiders in the Jurassic age.—See "American Naturalist," vols. v. (May, 1871), vi. (March, 1872), and viii. (October, 1874), for descriptions and figures. See also various articles on spiders by Dr. Burt G. Wilder, in "Proceedings of the American Association for the Advancement of Science," 1873, and the "Popular Science Monthly," April, 1875. For further details see chap. xviii. of Rennie's "Insect Architecture," the works of Kirby and Spence, and particularly the *Histoire des insectes aptères* (*Nouvelles suites à Buffon*), by Baron Walckenaer (vols. i., ii., and iii., 8vo, Paris, 1837–'44). (See MITE, SCORPION, and SILK SPIDER.)



Common House Spider (Tegenaria medicinalis).

Common Epeira (Epeira vulgaris).

**SPIDER CRAB,** or **Sea Spider,** the name of several species of ten-footed short-tailed crustaceans of the crab family, and more particularly of the *libinia canaliculata* of North America and the *maia squinado* of Europe. In *L. canaliculata* (Say) the thorax is densely hairy, with spines on the borders and on the back; the rostrum is grooved at the tip and channelled between the eyes; the anterior feet are unarmed and granulated, the hands elongated, and the fingers white at tip. The body is convex and heart-shaped, 4 in. in diameter, the long legs spreading over 12 to 16 in.; the eyes small and very short; it is blackish green,

Spider Crab (Maia squinado.)

very active, and ferocious-looking; it is often caught in nets, and from the wharves and bridges of New England; it is not used for food. The *M. squinado* (Latr.), or corwich, is reddish, and 4 to 6 in. long; the body is covered with spines and hairs; it is found along the coasts of W. Europe and in the Mediterranean, making its appearance in Great Britain about May and remaining till September, greatly annoying the fishermen by frightening away fish and larger crabs and lobsters from the nets by its constant movements; it is eaten by the poorer classes; the young when first hatched are very unlike their parents; as many as 80,000 eggs have been found on a single female. The ancients believed it to be endowed with reason, and represented it suspended from the neck of Diana of Ephesus as an emblem of wisdom; it is also figured on their medals.—*Lithodes arctica* (Latr.) is also called spider crab; the body is spiny, and the long beak bifurcated; the hands small and unequal, the limbs long and hairy, and the fifth pair imperfect; it is reddish yellow, spreading about 20 in., and a hideous-looking species; it is found on the coast of Norway.

**SPIDER MONKEY, or Coaita.** See MONKEY.

**SPIEGEL, Friedrich,** a German orientalist, born at Kitzingen, near Würzburg, July 11, 1820. After studying at Erlangen, Leipsic, and Bonn, and spending several years in travel, he became in 1849 professor of oriental languages at Erlangen. Besides editing several Persian works, he has published *Einleitung in die traditionellen Schriften der Parsen* (2 vols., Leipsic, 1856–'60); *Die altpersischen Keilinschriften* (Leipsic, 1862); *Eranische Alterthumskunde* (2 vols., Leipsic, 1871–'3); and several grammars and minor treatises bearing on Iranian antiquities, religion, language, literature, and ethnology.

**SPIELHAGEN, Friedrich,** a German novelist, born in Magdeburg, Feb. 24, 1829. He studied at Berlin, Bonn, and Greifswald, and devoted himself to literature. His works are: *Clara Vere* (1857); *Auf der Düne* (1858); *Problematische Naturen* (1860, English translation "Problematic Characters," by Prof. Schele de Vere, New York, 1869), and its continuation, *Durch Nacht zum Licht* (1861; English translation, "Through Night to Light," by the same, New York, 1869); *In der zwölften Stunde* (1862); *Die von Hohenstein* (1863; English translation, "The Hohensteins," by the same, 1870); *Röschen vom Hofe* (1864); *In Reih und Glied* (1866); *Unter den Tannen* (1867); *Hammer und Amboss* (1869; English translation, "Hammer and Anvil," by William Hand Browne, 1873); *Die Pioniere* (1871); *Alle Zeit voran* (1872); *Was die Schwalbe sang* (1873; English translation, "What the Swallow Sang," 1873); *Ultimo* (1874); and *Liebe für Liebe* (1875), a drama, which has been played in Leipsic. He has translated Curtis's "Howadji" (Hanover, 1857), Emerson's "English Traits" (1858), American poems by various authors (Leipsic, 1859; 3d ed., 1871), Roscoe's "Lorenzo de' Medici" (1859), and several of Michelet's works. A collected edition of his works has been published at Berlin (10 vols., 1872–'3).

**SPIESS, Heinrich,** a German painter, born in Munich, May 10, 1832, died there, Aug. 8, 1875. He was the son of an engraver, completed his studies under Kaulbach, whom he assisted in his cartoon of "The Crusaders," and executed a celebrated copy of his "Angel carrying a Dead Child to Heaven." In 1855 he was employed by Kaulbach in decorating the Wartburg, and he was one of the school of artists known as "young Munich," led by Faltz. In 1856 he obtained a prize for his "Jacob Wrestling with the Angel," and in 1861–'2 he painted for the museum of Munich the great frescoes relating to the pilgrimage of Duke Henry the Lion to Jerusalem, and to his quelling the disturbances at St. Peter's at the coronation of the emperor Frederick I.

**SPIKE.** See NAIL.

**SPIKENARD.** The ancients, under the name of *nard* (Heb. *nerd*; Gr. *νάρδος*; Lat. *nardus*), made use of several roots having properties similar to valerian; one having its flowers (or leaves) in spikes was called spikenard (*nardus spicatus*), and, according to Boyle, was the plant now known to botanists as *nardostachys Jatamansi*, which belongs to the valerian family and is found in Bengal; it is now quite out of use except in the East. There were also a leafy nard, a rooting nard, and others designated by the names of the countries producing them.—The plant called spikenard in this country is *aralia racemosa*. Other species of *aralia* are mentioned under GINSENG and SARSAPARILLA. This has a herbaceous, widely branched stem, 3 to 5 ft. high, from a perennial root; the large decompound leaves ternately or quinately divided with heart-ovate leaflets; the flowers, in umbels, which are united to form large panicles, are polygamous or perfect, greenish white, and succeeded by small dark purple berries. The plant is found from Canada southward, and is sometimes seen in gardens of medicinal plants; both root and berries have a warm, aromatic taste, and a tincture of them made with spirits is in some parts of the country a popular domestic stimulant. The root appears to be a stimulant diaphoretic, and was held in high esteem by the Indians.

**SPINACH,** a plant of the *chenopodiaceæ* or goosefoot family, *spinacia oleracea*, the leaves of which are used as food. According to some authors, the botanical and common names are derived from the Latin *spina*, a thorn, as some varieties have prickly seeds; others say that it is called in various languages by names equivalent to *Hispanica*, Spanish. Spinach was not known to the ancients, and it was a novelty in Europe in the 16th century. It is probably a native of western Asia. The plant is cultivated both as an annual and a biennial; it has petioled, ovate or triangular, succulent leaves;

the flower stalks are 2 to 3 ft. high, hollow, furrowed, and branching; the apetalous flowers are diœcious, the male in long spikes, the female in clusters at every joint of the stem; the calyx in the pistillate flowers hardens and forms an involucre to the seeds, and in some

Spinach.

varieties has two or three horns on the sides. But few varieties are known, the principal being the prickly, the smooth-seeded, and the lettuce-leaved.

**SPINAL CORD.** See Nervous System.

**SPINAL DISEASES,** the common appellation of diseases affecting the bony spinal column and the spinal cord and its membranes. The principal diseases of the spinal column are lateral curvature and angular curvature or Pott's disease, sometimes called scrofulous caries of the spine. Lateral curvature is the more common, and usually affects girls between 10 and 20 years of age and women of sedentary habits. Those who take much exercise are not often its subjects, as the symmetry of the spinal column is preserved principally by the action of the muscles. In its early stages lateral curvature is apt to escape detection, the first notice taken of it being generally the prominence of one shoulder, more frequently the right, or some elevation of the hip. The curvature is always double; that is, when a curve has taken place in the upper dorsal region, a complementary curve in the opposite direction will be found in the lumbar region, giving the spine a sigmoid appearance. Lateral curvature is also usually accompanied with more or less rotation of the spinal column, due to the action of the ribs, which are carried down on one side more than on the other. The treatment in slight cases is good diet, pure air, and well regulated exercise, and sometimes the administration of ferruginous tonics. When the curvature is considerable, stays, braces, and bandages will be of service; but they must not take the place of exercise, and should be regarded as expedients rather than curative agents. Posturing and great attention to the position of the body when lying in bed should be employed as the chief hygienic measures.—Angular curvature, or Pott's disease, is caused by inflammation of the bodies of the vertebræ and of the intervertebral substance, usually commencing in the latter. It is often accompanied with tubercle, and some hold that it is essentially a scrofulous disease. The immediate cause of the curvature is caries, and it most commonly shows itself during the period of bodily development, usually attacking the lower dorsal region. Recovery sometimes takes place without pus making its appearance, but "spinal abscess" is a common accompaniment, the pus pointing in the groin, and finding its way from the dorsal region beneath the fascia of the psoas muscle, under Poupart's ligament, forming what is known as "psoas abscess." The pus sometimes burrows beneath the muscles and involves the whole thigh. The abscess sometimes appears above Poupart's ligament, and sometimes in the loin, forming in the latter case "lumbar abscess." When the cervical vertebræ are affected, the abscess appears in the pharynx. Angular curvature is not difficult of diagnosis, as the ill health, suppuration, and deformity are highly indicative. The initiatory symptoms are also not obscure, the principal being the persistent local pain and difficulty in bending the back, accompanied by great general disturbance and hectic fever. After curvature has taken place recovery is always accompanied by anchylosis, from union of newly formed bony tissue. The treatment requires careful attention to the general health, including good diet and the employment of tonics and alteratives, such as iron, quinine, iodine, and cod-liver oil. The local applications of fomentations and leeches and of counter-irritants are also serviceable. Setons, moxas, and mercury, as tending to exhaust the strength, are to be avoided. On getting up, the patient's back should be supported by some kind of mechanical appliance. The abscess should not be opened too hastily, for it may be absorbed; but when it progresses steadily a free opening should be made, under a piece of lint saturated with carbolated oil, to prevent entrance of air.—The principal diseases of the spinal cord, that is, the pathological conditions to which it is subject, are spinal meningitis, myelitis, and spinal apoplexy. These conditions give rise to or aid in developing a variety of symptoms, which in turn are classed as diseases, such as paralysis (including paraplegia and spinal hemiplegia), general spinal paralysis, and locomotor ataxia. The diseases known as progressive muscular atrophy and infantile paralysis, although their causes are not clearly made out, are generally considered to be connected with affections of the spinal cord.—*Spinal Meningitis*, or inflammation of the membranes of the spinal cord, corresponds to inflammation of the corresponding membranes of the brain, and rarely occurs in the arachnoid and pia mater independently of cerebral meningitis, except in cases pro-

duced by injuries or diseases of the spinal column, or structural affections within the spinal canal. The affection is therefore almost always cerebro-spinal. (See BRAIN, DISEASES OF THE.) Fibrinous exudation, serous effusion, and generally pus follow the inflammation, the serum being often tinged with blood. The attack may be acute or chronic. When acute it extends over the whole or greater part of the membranes of the cord, but chronic meningitis is usually limited in extent, and the inflammation is accompanied by fewer pathological changes. Acute spinal meningitis is regarded by many authorities as incurable, while others assert that mild cases sometimes recover. The symptoms are pain in the spine and in the extremities, increased more by movements of the body than by pressure. There are also spasms of the muscles of the back, either persistent or convulsive, often producing that rigid bending of the body backward called *opisthotonos;* also tonic contraction of the thoracic muscles, and consequently difficulty of breathing. These symptoms are followed by paralysis, caused by pressure of the products of the inflammation (fibrinous exudation, effused serum, or pus). The paralysis may be confined to the lower extremities, or it may be general, and it is usually limited to motion, while there is preternatural sensibility. The disease runs a rapid course, often terminating fatally within a week. Apnœa, or suspension of the respiratory function from involvement of the roots of the respiratory nerves, is the usual mode of death. The treatment, in cases not dependent on blood poisoning, comprises the application of cups and leeches, setons, moxas, blisters, antimonial ointment, and croton oil, and also of belladonna and chloroform and the warm bath to relieve pain. Iodide of potassium is often given in large doses to promote absorption of the products of inflammation. The diet should be nutritious, but some authorities interdict the use of animal food.—*Epidemic Cerebro-Spinal Meningitis.* Although there are cases of cerebro-spinal meningitis which are idiopathic, and it is therefore then to be regarded as truly a spinal disease, the vast majority of cases are of epidemic origin, and the spinal lesions are therefore secondary affections, depending upon blood poisoning. The disease is then called epidemic cerebro-spinal meningitis, a dangerous affection which has of late prevailed extensively in different parts of the United States and Europe. From the appearance of certain spots upon the skin during the course of the disease it has been proposed to call it spotted fever; but as these spots are not a constant accompaniment, the proposition has not been adopted. The name was given to an epidemic which prevailed in New England between 1807 and 1816, which is supposed by many to be the same disease, but the identity is not established. Some have regarded epidemic cerebro-spinal meningitis as a variety of typhus, but the greater suddenness of the attack and the absence of the mulberry rash of typhus indicate a difference of origin. The disease usually begins with a chill, followed by great vertigo, violent headache, obstinate vomiting, and muscular stiffness, which soon passes into tetanus. The face is pale, the pupils contracted, the conjunctivæ red, and the skin exceedingly sensitive. The head is strongly drawn back, even at the end of the first or second day, and there is delirium, which soon passes into the stupor of coma. The bodily temperature is variable, the highest occurring in the most rapidly fatal cases. Wunderlich recognizes three forms. One, rapidly fatal, is accompanied by a high temperature, which rises toward the approach of death to 108° F., and continues to rise for some hours after death. A second form is slight, with fever of short duration and very irregular course; a third is protracted, but marked by very great variation of temperature. The pulse at the commencement is usually not more frequent, often slower than normal, and is often intermittent. It increases with the disease, but rarely reaches more than 100 beats per minute until near the fatal termination, when it becomes very small and frequent. The urine is increased in quantity and deposits a large amount of urates, and there is sometimes hæmaturia. In from 20 to 60 hours after the commencement a peculiar eruption usually appears upon the skin of the neck, abdomen, back, arms, legs, and face, composed of distinct dark red or purple spots, somewhat larger than a pin's head. They are not raised above the surface, and do not disappear upon pressure; sometimes they do not become visible till after death. The tongue is moist and creamy until the spasmodic stage is established, when it becomes dry, dark-colored, and covered with sordes. The duration of the disease varies from a few hours to several weeks; cases are reported as terminating fatally in three or four hours, but more than half the deaths occur between the second and fifth days. Convalesence may begin from the fifth day to the fourth week or later, and is always tedious, relapses being common and often fatal. The treatment is various. Bloodletting has been practised, but with unfavorable results, as might be expected from the depression of the vital powers. The use of quinia is regarded with favor, and opium has its advocates; ether and chloroform have been used by inhalation as sedatives; and tincture of cantharides is said to be of service in cases marked by extreme depression. Counter-irritation, by the actual cautery applied along the spine, or by blisters, has been followed by alleviation of symptoms. The use of cold compresses to the head, and of leeches behind the ears, is also recommended.—*Myelitis,* or inflammation of the body of the spinal cord, is similar to cerebritis, or inflammation of brain tissue, and may terminate fatally either in the acute inflammatory stage, or by softening, by unde-

fined suppuration, or by abscess; the most common mode being by softening, the disorganization involving the whole cord or only one column. Acute myelitis, except as a sequel to spinal meningitis, or when caused by a wound, is rare. The symptoms are similar to those of spinal meningitis, and it must be borne in mind that the two diseases are rarely unconnected, one inducing the other, the primary disease being predominant. Paralysis often comes on in a few hours, and is more pronounced than in meningitis. It is usually confined to the lower limbs, but involves the upper extremities when the affection reaches as high as the fifth pair of cervical nerves. When the inflammation is in the upper cervical and occipital sections of the cord, death may take place almost immediately from arrest of respiration. In chronic affections the palsied limbs usually become atrophied, and induration or sclerosis of the cord ensues, caused by an abnormal growth of connective cellular tissue, accompanied by atrophy of nerve tissue. Myelitis attacks subjects of all ages, but more commonly adults, and is more frequent in the male than in the female sex. The treatment depends upon the intensity of the attack; in the majority of acute cases little more can be done than to endeavor to relieve the most urgent symptoms, such as promoting the action of the bowels and preventing retention of urine. Strychnia may be sometimes used in the earlier stages of acute myelitis with advantage, and so may the electric current, and in chronic cases with decided benefit.—*Spinal Apoplexy*, or hæmorrhage within the spinal canal, may be caused by injuries to the spinal membranes, or by degeneration of the cord. Extravasations of blood derived from the membranes are chiefly formed in the lower part of the spinal canal, and the changes found in the substance of the cord, and the blood clot, are similar to those in cerebral apoplexy, as described in BRAIN, DISEASES OF THE. The effusions cause irritation, pain in the back, spasm of muscles below the seat of injury, and finally paralysis. Spinal apoplexy is distinguished from other paralytic affections by observing that the attending paralysis is usually not accompanied by fever or general loss of nervous power, and other symptoms. The treatment is rest and attention to the general state of the health, with moderate counter-irritation.—*Progressive Locomotor Ataxia* (Gr. ἀταξία, want of order). This name has been given to a form of paralysis characterized by disorderly muscular movements in consequence of loss of coördinating power, which has been recognized only within the present century. Duchenne described it in 1858–'9 more fully than any previous author, and gave it its name. Its pathology and location had been pointed out by Dr. Todd, but its causes were more fully investigated by Duchenne. Romberg called the disease *tabes dorsalis*, and it has also been called myelo-phthisis. There is not much loss of muscular power, except as general debility advances, but the diminution of sensation is more marked. The patient has a peculiar gait in walking, throwing the legs out in a jerking and uncertain manner, and when the disease is pretty well advanced throws his arms out like a man balancing on a tight rope. He seems to be somewhat in the condition of one who is walking in the dark over uneven ground. That which has been termed the "muscular sense" is impaired. The harmony of the reflex impressions by which muscular contractions are regulated and the limbs moved and adjusted is so far disordered that either too much or too little contraction is produced at each step. The foot will be thrown out and not properly brought to the ground, and as if to relieve this deficiency the patient by an effort of the will brings the foot down at the next step with too much force. A chief characteristic is the inability to walk or stand with the eyes closed. It needs the assistance of sight to keep the body erect. The walk is uncertain and reeling even with the eyes open, but if the patient shuts them he will fall. As the disease progresses, the upper extremities become affected, and it is difficult for the patient to tie his cravat or button his coat, or perform any motions requiring coördination of muscular movements. There are certain premonitory symptoms which have been relied upon, such as fugitive shooting pains in different parts of the body, of a neuralgic character; but they are often found unconnected with the disease, and often absent when the disease is present. One of the early symptoms is incontinence of urine consequent upon relaxation of the sphincter muscle, and an irritable state of the mucous membrane of the bladder; and there is often increased sexual activity, which however declines in the progress of the complaint, and at last ends in impotence. A characteristic feature of the disease is transient localized paralysis, such as that of the sixth pair of cranial nerves, which supply the external straight muscle of the eyeball, or the third pair, which supply the elevators of the eyelid, and the constrictor of the iris, so that there is drooping of the lid and dilatation of the pupil, one eye being usually affected more than the other, and vision is sometimes impaired or lost. In some cases these paralytic affections are permanent. When the paralysis of the limbs begins on one side, which it frequently does, it is much oftener upon the left than the right side. Before the disease is much advanced, although the gait is irregular and jerking, the patient retains the power to walk considerable distances in spite of the great exertion which he makes. After a time the power of locomotion is lost, the patient is confined to his bed, he becomes unable to feed himself, and speech is difficult, sometimes impossible. The disease is distinguished from ordinary paraplegia, or anterior spinal paralysis, by the careful and circumspect

gait of the latter; and although it has some symptoms in common with general paralysis of the insane, the totality of them will enable a diagnosis to be made. The prognosis is extremely unfavorable; very few cases ever cease progressing, and fewer still recover. The most that can be hoped for is that the disease will remain stationary or progress slowly. Sometimes it develops rapidly, but generally years elapse before the fatal termination, and in most cases death is produced by some intercurrent affection. The most marked pathological condition is induration or sclerosis of the posterior columns of the spinal cord, involving the gray substance and the roots of the posterior nerves. The sclerosis is an abnormal development of the connective tissue, and produces atrophy and degeneration of the nerve fibres. Among the most frequent causes of progressive locomotor ataxia are exposure to wet and cold, mechanical injuries, and syphilis. Severe blows and falls, and the concussion produced by railroad collisions and similar shocks, often occasion that congested condition of the spinal cord which ends in locomotor ataxia. Excessive and continued mental exertion, and anxiety or grief, by producing a hyperæmic condition of the brain and spinal cord, sometimes bring on the disease, especially if there is a constitutional fault. Excessive indulgence in the sexual passion has been regarded as a frequent cause, but some revision of opinion will need to be made on this point. The irritable condition of the cord often produces a morbid sexual desire which has not previously been characteristic of the patient, and in which he has not inordinately indulged, and many are now inclined to believe that the cause in question has been overrated. Males are more often affected than females. Of 60 cases analyzed by Carre, 42 were males and 18 females. It is especially a disease of middle life, between the ages of 30 and 50, although it sometimes occurs before 30, and Trousseau reports a case in a patient 80 years old. The disease is sometimes associated with general paralysis of the insane, sometimes one and sometimes the other disease appearing first. There is no particular plan of treatment established. In Europe and in this country success has seemed to attend the employment of the interrupted galvanic current (faradization), and cases are reported as having been benefited by the continuous current of a powerful battery. (See Medical Electricity.) Long continued and well regulated gymnastic exercises were successfully employed by Eisenmann in two out of six cases. The iodide and the bromide of potassium are beneficial. Counter-irritation with blisters, issues, and cautery has been found of no avail. Moderate exercise and a well regulated nutritious diet, to promote as much as possible the healthy assimilation of tissue, should be regarded as a main indication. Galvanism promises to be a powerful adjunct, but time is still required to measure its importance.

**SPINDLER, Karl**, a German novelist, born in Breslau, Oct. 16, 1796, died at Freiersbach, Baden, July 12, 1855. He was educated at Strasburg, joined in Germany a company of strolling players, and resided from 1832 at Baden-Baden. His reputation rests on his historical romances, *Der Bastard* (3 vols., Zürich, 1826), *Der Jude* (4 vols., Stuttgart, 1827), *Der Jesuit* (3 vols., 1829), and *Der Invalide* (5 vols., 1831). His complete works include 102 volumes (1831–'54), besides minor novels contained in his periodical publication *Vergissmeinnicht* (1830–'55).

**SPINE.** See Skeleton, and Spinal Diseases.

**SPINEL** (Fr. *spinelle*), a mineral, sometimes ranked among the precious stones, occurring in regular octahedrons and dodecahedrons, variously modified; hardness, 8; specific gravity, 3·5 to 4·9. The color is commonly some shade of red, but is sometimes blue, green, yellow, brown, black, and rarely almost white. When pure, it is a compound of magnesia 28, alumina 72; but the magnesia is often replaced to some extent by one or more of the protoxides of iron, zinc, or manganese, or by lime, and the alumina also by peroxide of iron; hence the numerous varieties of the species. These are denominated according to their colors, and some among them are often supposed to belong to other species. The black varieties are called pleonaste; the scarlet, spinel ruby; the rose red, balas ruby; the yellow, or orange red, rubicelle; the violet, almandine ruby; and the green, ceylonite. The *goutte de sang* of the jewellers is of blood-red or cochineal color. The mineral is infusible before the blowpipe alone, and is not attacked by acids. The most valuable spinels are found in Ceylon, Siam, and other eastern countries, in the form of rolled pebbles in river beds. They are also found in New Jersey, New York, and central Massachusetts. Perfect specimens fit for jewelry are rare; if of more than four carats, they are sometimes rated as worth half as much as diamonds of equal size. The red varieties are said to be sold for true rubies, from which they are with difficulty distinguished; and many of the others are often confounded with other precious stones of similar hardness and specific gravity. The optical properties alone may decide without analysis between the colorless spinel and the limpid topaz of Siberia. Dufrénoy was obliged to apply the test of polarization of light to a white cut spinel from India, which was supposed to be either a diamond or a white emerald. He describes one of a clear crimson with a violet tint, weighing 1,129 grains, of great beauty, valued at 100,000 to 110,000 francs.

**SPINK**, a S. E. county of Dakota, recently formed and not included in the census of 1870; area, about 800 sq. m. It is intersected by the Dakota or James river. The surface is rolling.

**SPINNING.** See Cotton Manufacture, Linen, Rope, and Wool, Manufactures of.

**SPINOLA, Ambrosio de,** marquis, a Spanish soldier, born in Genoa in 1569, died near Casale, Piedmont, Sept. 25, 1630. He was a son of the marquis Filippo Spinola, a party leader at Genoa and a rich Levant merchant, and his mother was a princess of Salerno. After filling local offices, he joined his brother Federigo, who had become admiral in the Spanish navy, in the war against the Dutch and English. In 1602 he arrived in the Netherlands with a corps of 9,000 veterans which he had raised and equipped at his own expense, and with which he came to the rescue of the Spaniards under Archduke Albert against Maurice of Nassau. His brother fell in a naval battle, May 26, 1603, and he was desired to succeed him as admiral, but preferred to become chief commander of the Spanish army in the Netherlands. He covered himself with glory in September, 1604, by compelling the surrender of Ostend, which had been besieged since July, 1601. After other operations against Maurice, who regarded him as next in genius to himself, he was in 1609 among the first to favor the truce for 12 years concluded at the Hague. During the truce he commanded Spanish troops in Germany. In 1622 he took Jülich; in the same year he was repulsed at Bergen-op-Zoom, but made a skilful retreat; and in 1625 he captured Breda after a siege of ten months. He afterward reluctantly became commander of the Spanish army in Italy, and died during the siege of Casale.

**SPINOZA** (also written SPINOSA), **Baruch,** or **Benedict,** a Dutch philosopher, born of Jewish parents in Amsterdam, Nov. 24, 1632, died at the Hague, Feb. 21, 1677. He translated his Hebrew name Baruch into Latin as Benedictus. His father, a Portuguese merchant, had fled from persecution to Holland. The son was educated for the rabbinical profession, and gained the admiration not only of the masters of the Hebrew school in Amsterdam, but also of the chief rabbi Morteira, who became his instructor in the Talmud and the Cabala. But he was suspected even before his 15th year of verging toward heresy, and was accused of contemning the law of Moses and denying the immortality of the soul and the reality of angelic communications. Summoned before a rabbinical tribunal, he anticipated excommunication by withdrawing himself from the synagogue. He neglected the repeated summons of the synagogue to trial, and at length in 1656 the *anathema maranatha*, or greater excommunication, was uttered against him. He was already familiar with the Portuguese, Spanish, Italian, German, and Flemish languages, and was studying Latin under the physician Van Ende. This language introduced him not only to Christian learning, but also to the literature and philosophy of classical antiquity, then studied with special enthusiasm, and opened to him the writings of Descartes. The Talmud makes it the duty of scholars to learn some mechanical art. Spinoza had therefore, while in the synagogue, learned the art of polishing lenses, by which he gained his subsistence during the remainder of his life. Exiled from Amsterdam by the magistrates on application of the rabbis, he lived for a short time with a friend in the vicinity, went thence to Rhynsburg, near Leyden, whence in 1664 he removed to Voorburg, near the Hague, and finally yielded to the request of his friends to reside entirely at the Hague, all the leisure time saved from labor being given to philosophy. After the death of his parents his sisters attempted to deprive him of his portion of the inheritance. Having established his rights by law, he contented himself with taking only a bed. In 1673 the professorship of philosophy in the university of Heidelberg was offered to him, the condition being that he should teach nothing opposed to the established religion; but he declined it. When it was proposed to obtain a pension for him from Louis XIV., he replied that he had nothing to dedicate to that monarch. Meanwhile he endured the toil and wants of poverty, and was wont to protract his labors into the night. His first work, *Renati Des Cartes Principiorum Philosophiæ Pars I. et II., More Geometrico Demonstratæ* (Amsterdam, 1663), which contains in an appendix the germ of his *Ethica*, immediately gave him the reputation of a great philosopher. His second work, *Tractatus Theologico-Politicus*, published anonymously in 1670, treats the relation between church and state, and is entirely distinct from his philosophical writings. Religion, he maintained, is neither doctrine nor *cultus*, but is essentially the love of God, the expression of which is piety and obedience, and its worship is virtue. Doctrines belong to the domain of philosophy, actions to that of the state, feelings to that of religion. Absolute freedom should prevail in the first and the last, while the second should be regulated by the state in the interest of order and tranquillity. He therefore advocated a state religion, which should ordain ceremonials, but leave liberty of thought inviolate. He referred for support of his opinions to the Bible, in which he distinguished between the facts narrated and the coloring received from the minds of the writers, and thus laid the foundation of the rationalistic school of interpretation in Germany. Numerous refutations of his work appeared, especially from Cartesian theologians; yet it was read throughout Europe, being published and translated with divers devotional, historical, antiquarian, and even medical titles employed to disguise it. Averse to controversy, Spinoza withheld his other and more important works, which were first published after his death by his friend Ludwig Meyer, a physician of Amsterdam. His health, never vigorous, suffered from unremitted confinement and devotion to study. He sometimes passed entire months without leaving his chamber, occupied only with meditation, conversation with his friends, and answering letters on philosophical sub-

jects. In a letter dated July 15, 1676, he promises further explanations "if my life be continued." After his death his manuscripts were, in accordance with his order, sent to his publisher at Amsterdam, and within a year appeared *Ethica, Ordine Geometrico Demonstrata*, containing his philosophical doctrine, which had been written between 1663 and 1666; *Tractatus de Intellectus Emendatione*, and *Tractatus Politicus*, both of them fragments; a collection of letters to Oldenburg, Simon de Vries, Ludwig Meyer, and Bleyenbergh; and a fragmentary sketch of Hebrew grammar, aiming to give it a logical development.—The whole system of Spinoza is a demonstration from the eight definitions and seven axioms of the first book of the *Ethica*. According to him, it follows from the definition of substance that it is necessary and infinite, that it is one and indivisible, and that it is therefore God, the only self-existent, all-perfect, and absolutely infinite Being. Nothing exists except substance and the modes of its attributes. Substance cannot produce substance, and therefore there is no such thing as creation, no beginning or end, but all things have necessarily flowed from the Infinite Being, and will continue to flow on for ever, in the same manner as from the nature of a triangle it follows, and will follow from eternity to eternity, that the angles of it are equal to two right angles. Of the infinite number of infinite attributes of Deity, only two are known to us, extension and thought, the objective and subjective of which he is the identity. Body is a mode of extension, which being illimitable cannot be divided; thought is also infinite, and mental acts are modes of it. It follows also that God is the only free cause (*causa libera*); all other things and beings move by fixed laws of causation, without free will or contingency. He is the *causa immanens omnium*, not existing apart from the universe, but expressed in it, as in a living garment. As conceived in his attributes simply and alone, he is *natura naturans;* as conceived in the infinite series of modifications which follow from the properties of these attributes, he is *natura naturata*. Between bodies, the modes of extension, and ideas, the modes of thought, there is a constant parallelism. The duality everywhere appears, and a soul belongs alike to animals, vegetables, and minerals. Man is a complex example of this compound. There is no reciprocal influence between the bodily and the ideal world, but a perfect harmony, since it is the same substance, affected in the same manner, but expressed under each of the two attributes. Individual beings, whether ideas or bodies, are modes, the changing forms of substance, to which they are related as wavelets to the ocean. The finite has no existence as such; substance is not made up of modes, but is prior to them; and Hegel therefore remarks that Spinoza rather denies the existence of the material universe than identifies God with it. The human mind has two chief ways of knowledge, the intuitive through the reason, and the imaginative. The imagination, which deals with the objects of experience, represents the world as a multiplicity of individuals. It obtains a partial and inadequate view of the images which appear before it, considers modes as things, and names them man, horse, tree, &c. The reason sees together in their unity what the imagination isolates and individualizes, and attains to adequate or exhaustive knowledge, to universal or divine ideas, which are pure thoughts, not involving the conception of extension, and not consisting in images or words. The mind is passive and in bondage in so far as it is influenced by inadequate ideas, and is active and free in so far as its ideas are adequate. If all objects of knowledge be regarded in their relations to the one absolute Being, the knowledge of particular outward things, nature, life, or history, becomes in fact a knowledge of God; and the more complete such knowledge, the more the mind is raised above what is perishable in the phenomena to the idea which lies beyond them. It dwells exclusively upon the eternal, is occupied with everlasting laws, emancipates itself from the conditions of duration, and secures its immortality, by becoming "of such a nature that the portion of it which will perish with the body, in comparison with that of it which shall endure, shall be insignificant." The law of passion is that all things desire life, seek for energy, for fuller and ampler being. Every single being pursues that which will give it increased vitality. Man gathers life and self-mastery only from the absolute Being; the love of God is the extinction of all other desires; and virtue is the knowledge and power of God in the human soul, the exhaustive end of human aspiration. The ethical principles in which the philosophy of Spinoza results were proposed by him as identical with those of the Christian religion.—The best complete editions of his works in the original Latin are by Paulus (2 vols., Jena, 1802–'3), Gfrörer (Stuttgart, 1830), and Bruder (3 vols., Leipsic, 1843–'6). There are German translations by Berthold Auerbach, with a biographical notice (5 vols., Stuttgart, 1841; new ed., enlarged, 1874), and by J. H. von Kirchmann and Schaarschmidt (1871 *et seq.*); French translations by Émile Saisset (2 vols., Paris, 1843; enlarged ed., 3 vols., 1861), and by J. G. Prat (1863 *et seq.*). Spinoza's newly discovered *Tractatus de Deo et Homine* has been edited by Van Vloten (Amsterdam, 1862; German and Dutch translations, 1870), and commented upon by Sigwart (Gotha, 1866) and Trendelenburg (Berlin, 1867). Among his biographers are Colerus (Dutch, 1698; French, 1706; German, 1733), Lucas (Amsterdam, 1719), Dietz (Dessau, 1783), Philippson (Brunswick, 1790), A. Saintes (Paris, 1842), Van Vloten (Amsterdam, 1862), and R. Willis (London, 1870). See also F. H. Jacobi,

*Ueber die Lehre des Spinoza in Briefen an Mendelssohn* (Berlin, 1785); Herder, *Gott, einige Gespräche* (Gotha, 1787); Sigwart, *Der Spinozismus historisch und philosophisch erläutert* (Tübingen, 1839); Kuno Fischer, *B. Spinoza's Leben und Charakter* (Mannheim, 1868); S. E. Löwenhardt, *Benedict von Spinoza in seinem Verhältniss zur Philosophie und Naturforschung der neueren Zeit* (Berlin, 1872); and *Die Ethik des Spinoza*, with the original text, edited by Hugo Ginsberg (Leipsic, 1875). In 1875 a movement was commenced for erecting a monument to Spinoza at the Hague on the 200th anniversary of his death, Feb. 21, 1877.

**SPIRÆA** (supposed to be from Gr. *σπειρεῖν*, to wind, some kinds being useful to form garlands), a genus of plants of the rose family, comprising about 50 species, widely distributed throughout the temperate and subarctic portions of the northern hemisphere. It includes both herbs and shrubs, some of which have received popular names, while for many cultivated species the botanical name is in common use. The alternate leaves are simple or compound, with mostly manifest stipules; the small white or rose-colored flowers (sometimes diœcious) are in dense or long, loose, terminal panicles or cymes, or in axillary umbel-like corymbs, and consist of a short, persistent, five-cleft calyx, with five equal petals, numerous stamens, and mostly five pistils (two to twelve),


1. Meadow Sweet (Spiræa salicifolia). 2. Hardhack (Spiræa tomentosa).

the ovaries to which become several-seeded pods or follicles in fruit. In some rare cases the parts of the flower are in fours instead of fives. —The most common native species, *S. salicifolia*, is known as meadow sweet and queen of the meadows, and is abundant in moist meadows and on the margins of swamps, where its slender, purplish, very brittle stems form clumps 3 ft. or more high; the variable leaves, mostly wedge-lanceolate, are simply or doubly serrate, acute or obtuse, thin, and mostly smooth; the flowers, in a crowded terminal panicle, are white or sometimes flesh-colored; it remains in flower from July to September, and is sometimes cultivated. A hybrid variety, said to be produced from this and Douglas's meadow sweet (*S. Douglasii*), of the N. W. coast, has longer flower clusters, of a lively rose color, and is a garden favorite on account of its long continued bloom.—Hardhack and steeple bush are common names for *S. tomentosa*, found in low grounds from Canada to Georgia, but more abundant in New England than elsewhere; the stems, smooth and dark bronze-colored when old, are 2 or 3 ft. high and thickly furnished with ovate or oblong serrate leaves, covered on the under surface with a very thick woolly down, which is whitish or slightly rusty, and in marked contrast with the very dark green of the upper surface; the flowers, appearing in July and lasting till autumn, are in a dense, tapering, spire-like panicle, rose-purple, or rarely white. The plant is very astringent, and is used as a domestic remedy, and by physicians as a tonic and astringent in diarrhœa and other bowel complaints.—The largest of our native species, *S. opulifolia*, grows in its different forms from Canada to the gulf states, and west to Oregon and California; it is a rugged shrub, from 4 to 10 ft. high, with long recurved branches and a loose bark, the numerous layers of which, spontaneously separating, have caused it to be called nine-bark; its roundish heart-shaped leaves are often three-lobed and doubly serrate; the abundant white flowers are in umbel-like clusters, and are succeeded by bladdery pods which turn purplish. The golden spiræa (*S. aurea* of the catalogues) is only a variety of this, in which the leaves when young are bright greenish yellow; it is very showy in spring, while the foliage is fresh; this is sometimes used with good effect for ornamental hedges.—Among the many shrubby species in cultivation the most frequent are: the plum-leaved spiræa (*S. prunifolia*), from Japan, with smooth lanceolate leaves, and in the form generally cultivated very double pure white flowers; Reeves's spiræa (*S. Reevesiana* of the catalogues, but properly *S. lanceolata*), from China, with numerous umbels of white flowers; St. Peter's wreath or Italian May, with long recurved branches crowded with small sessile umbels of white flowers; Fortune's spiræa (*S. Fortunei* or *callosa*), from China, with long slender stems bearing flat corymbs of rose-pink or white flowers; *S. ariæfolia*, from Oregon, with terminal panicles of yellowish white flowers; and Thunberg's spiræa (*S. Thunbergii*), from the mountains of Japan, a dwarf species, with small flowers in clusters of three. The tall Chinese shrub, with flowers

several times larger than the others, and formerly called *S. grandiflora*, is now placed in a separate genus, *exochorda*.—Among the herbaceous species, the finest native is the queen of the prairie (*S. lobata*), found wild from Pennsylvania to Kentucky, and common in cultivation, with small flowers of a peach-blossom color. Goats' beard (*S. aruncus*) is another native from New York westward, found also in Europe, with numerous slender spikes of diœcious, whitish flowers. Dropwort (*S. filipendula*), from Europe, has large cymes of white or pink-tipped flowers. The fine herbaceous plant which is often called *spiræa Japonica* belongs to the saxifrage family; its proper name is *astilbe Japonica.*

Dropwort (Spiræa filipendula).

**SPIRAL VESSELS.** See Air Vessels.

**SPIRE,** or **Spires** (Ger. *Speyer* or *Speier*), a town of Bavaria, capital of the district of the Palatinate, on the left bank of the Rhine, at its junction with the Speyerbach, 16 m. N. E. of Landau; pop. in 1871, 13,241. It has a cathedral in the Romanesque style, remarkable for its size and antiquity; it was damaged by the French in 1689, but has been partly restored with great splendor; it contains the tombs of eight emperors, fine monuments, and a hall of antiquities. Very little is left of the imperial palace, where in 1529 the diet was held at which the Reformed princes made the protest from which originated the name of Protestants.—Spire was a Roman military station under the name of Augusta Nemetum (previously Noviomagus), and is said to have had a Christian community in the 2d century, and a bishop in the 3d. In the 7th century it was known under the Latin name of Spira. The town became of great importance as the ordinary residence of the emperors of Germany, and the seat of the imperial chamber or supreme court of appeal and of several diets. The French laid it in ashes May 31, 1689. It was rebuilt in 1699, but never recovered its ancient prosperity. After the French occupation (1801–'14) it was in 1816 given to Bavaria.—The bishopric of Spire, one of the oldest in Germany, long enjoyed the rights of sovereignty, and the prince-bishops, whose castle was at Bruchsal, had an enormous income. More than half of the territory was given to France by the treaty of Lunéville, Feb. 9, 1801, and the rest to Baden in 1802.

**SPIRIT OF SALT.** See Hydrochloric Acid.

**SPIRITUALISM,** a term formerly used to designate the doctrines and religious life of a class of mystics who professed to be under the sensible guidance of the Divine Spirit, and who were distinguished by a habit of spiritualizing the Sacred Scriptures. Jacob Boehm, Miguel de Molinos, Mme. Guyon, and Mme. de Bourignon, though not all ostensibly of the same communion, are representatives of the somewhat numerous class of religionists, particularly of the 17th century, to whose teachings and practice the appellation of spiritualism has been applied. Latterly, however, the word has been employed exclusively to designate the belief of those who regard certain accredited phenomena, physical and mental, as the result of the action of spirits, influencing and using persons of a peculiarly sensitive organization, known as mediums. In France Allan Kardec (the pseudonyme of Léon Hippolyte Denisart Rivail), who specially investigated the American phenomena, defined it as follows: "Properly speaking, spiritualism is the opposite of materialism. Whoever believes he has within him something distinguished from matter is a spiritualist; but it may not follow that he believes in the existence of spirits, or in their communications with the visible world. To designate this latter belief we employ, in place of the words spiritualism, spiritualist, the words spiritism, spiritist." Spiritualists assert that phenomena nearly identical with the manifestations of modern spiritualism appear in many ancient histories, in the Delphic oracles, in the lives of seers and clairvoyants, in the facts of witchcraft in all ages, in the Tedworth occurrences related by Glanvill (1661), in the Camisard marvels in France (1686–1707), in the occurrences in the Wesley family (1716), in Swedenborg's alleged full and open communication with the spirit world and daily converse with spirits and angels more than a century ago, in the records of mesmerism and somnambulism, in the traditions of countless families, and in the innumerable published accounts of remarkable dreams, predictions, and physical phenomena.—Clairvoyance appears to have played an important part in the introduction of modern spiritualism, and a historical sketch of the latter, to be complete, must include some notice of the former. Jung-Stilling (1740–1817), in his writings on pneumatology, noticed that clairvoyants, during their more exalted states of *ecstasis*, professed, with what seemed to him satisfactory evidence, to be in converse with invisible in-

telligences. The same claims to open intercourse with the spiritual world, with many phenomenal evidences which he regarded as establishing their truth, were afterward noted by Dr. Justinus Kerner, and detailed at large in his biography (1829) of one of his patients, Frederica Hauffe, more familiarly known as the seeress of Prevorst, who is said to have been in a magnetic state for most of the time during the last seven years of her life, describing the persons and repeating the language of what she represented to be spirits, and being often accompanied with mysterious rapping sounds. In 1830 Bertrand and other students of mesmerism came upon the borders of spiritualism. The correspondence (1836) between the French mesmerists Billot and Deleuze shows that they were aware of some of the marvels asserted by the later spiritualists. Billot writes that he and his co-sectaries had both seen and felt the spirits. Deleuze declared that the possibility of communicating with spirits had been proved to him, and he also cites the testimony of a distinguished physician concerning clairvoyants who "cause material objects to present themselves." Many instances of alleged intercourse with the invisible world subsequently occurred in France, Germany, and other parts of Europe, and in the United States. In the spring of 1843 the societies of Shakers at New Lebanon and Watervliet, N. Y., and several other communities of that fraternity, almost simultaneously became the subjects of strange psychological experiences, during which certain of the members would lose all personal consciousness, while influences purporting to be the spirits of persons of different nations, who had lived in the world in different ages, took possession of their bodies, and spoke through their vocal organs. None of the phenomena of clairvoyance were more remarkable than those in the case of Andrew Jackson Davis. (See Davis, Andrew Jackson.) Thrown into an abnormal state of mind and body by the process of magnetism, this young man, while professing to be in immediate converse with the spiritual world, dictated a large octavo volume, which was published under the title of "The Principles of Nature, her Divine Revelations, and a Voice to Mankind." In a portion of this book that was dictated in 1845 (pp. 675–'6) the entranced author distinctly predicted that the communication with the spiritual world would ere long assume "the form of a living demonstration." It is noteworthy that, although Davis was almost wholly uneducated, his first and subsequent works, conceived when he was in a clairvoyant state, or while more or less illuminated, as he claims, by the influence of invisible spirits, are written in correct and oftentimes elegant language.—The "spirit-rapping" phenomenon began in March, 1848, in the family of John D. Fox, in Hydeville, Wayne co., N. Y. Besides Mr. and Mrs. Fox, only their two youngest children, Margaret, 12 years old, and Kate, 9 years old, were at home when the family was startled by mysterious rappings that were heard nightly upon the floor of one of the bedrooms, and sometimes in other parts of the house. They endeavored to trace the sounds to their cause, but failed. It is also alleged that a patter of footsteps was sometimes heard, the bedclothes were pulled off, and Kate felt a cold hand passed over her face. On the night of March 31, when the raps occurred, Kate imitated them by snapping her fingers, and the raps responded by the same number of sounds. Kate then said: "Now do as I do; count 1, 2, 3, 4, 5, 6," at the same time striking her hands together. The same number of raps responded, and at similar intervals. The mother of the girls then said: "Count 10;" and 10 distinct raps were heard: "Count 15," and that number of sounds followed. She then said: "Tell us the age of Cathy [the youngest daughter] by rapping one for each year," and the number of years was rapped correctly. In like manner, the ages of each of four other and then absent children were by request indicated by this invisible agent. Mrs. Fox asked if it was a human being that was making that noise, and if it was, to manifest it by making the same noise. There was no sound. She then said: "If you are a spirit, make two distinct sounds." Two raps were accordingly heard. Three weeks afterward, it is said, it was made known by the raps that the body of a murdered man lay buried in the cellar, and the exact spot was indicated where parts of a human skeleton were actually found. The name of the murdered man was given, and it was learned that five years before such a person had visited the house and had suddenly and mysteriously disappeared. After a while the raps occurred only in the presence of the two sisters, Margaret and Kate. The family having removed to Rochester, the raps accompanied them, and new phenomena, including clairvoyance and the movement of ponderable bodies without appreciable agency, were developed. In November, 1849, the Fox girls appeared in a public hall, and the phenomena were freely manifested and subjected to many tests; and a committee appointed for their investigation, after continuing their experiments there and elsewhere for several days, reported that they were unable to trace them to any mundane agency. In May, 1850, the Fox girls arrived in New York; the alleged spiritual manifestations became the subject of extensive newspaper and conversational discussion; their facts were published far and wide; "mediums," through whom they were said to occur, sprang up in different parts of the country, and were multiplied by hundreds and almost by thousands. In that year D. D. Home (see Home, Daniel Dunglas), at the age of 17, became known as a medium, and in the five following years he attained a wide-spread reputation, especially for his materialization, levita-

tion, and other phenomena far surpassing the previous manifestations of ordinary mediums. Some of the most remarkable manifestations through his mediumship occurred in Springfield, Mass., and in Hartford, Conn., at the residences of Henry C. Deming, Isaac W. Stuart, Alfred E. Burr, and others. In 1855 he went abroad, and gave sittings with manifestations in the presence of Napoleon III. in Paris and Alexander II. in St. Petersburg; and both emperors gave him large presents in jewels and money. Nearly contemporary with Home, and since his publicity as a medium, many others in the United States and in Europe have obtained an almost equal celebrity for materializing manifestations. Among the mediums of the alleged spiritual manifestations there have been representatives from all classes and conditions of mankind. The alleged mediums have been classified as rapping mediums; mediums for tipping and turning tables by a slight touch of the finger; for the movement of ponderable bodies without contact; for the production of phosphorescent lights in a dark room; for playing on musical instruments in a manner beyond their ordinary abilities; for involuntary writing, and for writing independent of any apparent aid from human hands; for direct spirit speech, and for impressional speaking and personation; for stigmata; for the diagnosis and healing of disease; for levitation; for producing drawings and colored pictures; for photographing spirits; for the introduction of flowers, fruits, vegetables, and many other things into closed rooms; for the development of other mediums; and finally, what spiritualists consider the crowning marvel of all the manifestations, for the materialization of spirit forms identical in appearance with those of deceased persons. Indeed, the powers that are claimed for mediums are protean in variety. By the raps and tipping of tables, and by the control of the medium's organs to write and speak, the spirits are supposed to express their own peculiar intelligence in a degree of perfection proportioned to the development and passivity of the medium. It is averred that persons while under the spiritual afflatus have often spoken in foreign tongues which they had never learned; and writings in languages to them unknown have been produced in their presence, as we are told, by invisible hands. To all these modes of manifestation there are countless witnesses of high character and intelligence. In the "London Quarterly Journal of Science" for January, 1874, William Crookes, the editor, classifies some of the phenomena exhibited in repeated experiments with the mediums D. D. Home and Kate Fox (afterward Mrs. Jencken) as follows: 1, the movement of heavy bodies with contact, but without mechanical exertion; 2, the phenomena of percussive and other allied sounds; 3, the alteration of weight of bodies; 4, movements of heavy bodies when at a distance from the medium; 5, the rising of tables and chairs off the ground without contact with any person; 6, the levitation of human beings; 7, movements of various small articles without contact with any person; 8, luminous appearances; 9, the appearance of hands, either self-luminous or visible by ordinary light; 10, direct writing; 11, phantom forms and faces; 12, special instances which seem to point to the agency of an exterior intelligence; 13, miscellaneous occurrences of a complex character. The exhibitions which Mr. Crookes and a few friends witnessed were mostly in his own house, in the light; and it is said that the existence of an unexplained force, with its amount and direction, was accurately tested by means of an ingenious apparatus. In the spring of 1874 Mr. Crookes with others began the investigation of phenomena exhibited in London through the mediumship of Florence Cook, afterward Mrs. Corner. It is asserted that in a series of sittings extending through several months a female spirit form, temporarily materialized and not distinguishable from a human being, repeatedly came from a cabinet into the light, conversed, sang, submitted to various tests, and then disappeared. Mr. Crookes, who took several photographs of the figure, says: "It was a common thing for the seven or eight of us in the laboratory to see Miss Cook and 'Katie' (the spirit) at the same time under the full blaze of the electric light." On one occasion Mr. Varley, the electrician, by means of a galvanic battery and cable-testing apparatus, showed to the satisfaction of the spectators that the medium was inside of the cabinet while the supposed spirit form was visible and moving outside. Two years previously the phenomena of materialization appeared at Moravia, N. Y., where Mrs. Mary Andrews was the medium; and Thomas R. Hazard of Rhode Island, the Rev. R. S. Pope of Hyannis, Mass., and other respectable persons present at these sittings, declared that they saw and conversed with the spirits of their deceased relatives and friends. Numerous credible witnesses, prominent among them Henry S. Olcott of New York, who devoted weeks to special investigation, testify that similar phenomena occurred in 1874–'5 at the sittings with the Eddy brothers in Chittenden, Vt. Mr. Mott of Memphis, Mo., Mrs. Anna Stewart of Terre Haute, Ind., and Mrs. Markee of Havana, N. Y., have the reputation of being remarkable mediums for the materialization phenomena. The fraudulent character of some exhibitions has been exposed, notably of that of the Holmeses in Philadelphia in 1874, in which the supposed spirit form called "Katie King" appeared. To this exhibition Robert Dale Owen at first gave full credence, but he ultimately withdrew his confidence, though subsequent investigations threw doubt on the charges of imposture through a confederate. Almost from the time of the first sittings the phenomena of materialized spirit hands and

feet have been common. Instruments have been floated around and spirit voices heard, phenomena supposed to be produced by the exercise of the materializing power. But notwithstanding the accumulated assumed testimony in regard to spirit photographs and materializations, spiritualists themselves are not yet unanimous in admitting them among what they believe to be fully verified phenomena.—Besides the thousands in every grade of society, throughout the civilized world, who are more or less influenced by a belief in the supernatural origin of the manifestations, many persons in Europe and America, distinguished in the walks of science, philosophy, literature, and statesmanship, have become avowed converts, or have admitted the phenomena so far as to believe in a new force not recognized by science, or have testified that the manifestations they have witnessed are not capable of explanation on the ground of imposture, coincidence, or mistake, or at least have considered the subject worthy of serious attention and careful consideration. Among these are: Alexander Aksakoff, Robert Chambers, Hiram Corson, Augustus De Morgan, J. W. Edmonds, Dr. Elliotson, I. H. von Fichte, Camille Flammarion, Hermann Goldschmidt, Dr. Höffle, Robert Hare, Lord Lyndhurst, Robert and Robert Dale Owen, W. M. Thackeray, T. A. Trollope, Alfred Russel Wallace, Nicholas Wagner, and Archbishop Whately. As the organized bodies of spiritualists include but a small proportion of those who wholly or partially accept these phenomena, it is impossible to make even an approximate estimate of their numbers. While spiritualism has its converts from every religious denomination, no small proportion of its advocates are from the ranks of those who previously doubted or totally disbelieved the immortality of the soul, and who affirm that they carry their skeptical tendencies into the investigation of this subject. On matters of speculative theology, there seems to be among them the widest latitude of opinion, though a majority of them perhaps are in their speculations inclined to what may be termed a sublimated naturalism. They tell us that it is not the object of the spirits to teach theological dogmas as by any authority superior to that of man, but rather, by the mental and physical phenomena incidentally presented in the course of their manifestations, to furnish those elements of reasoning from which each one may work out his own conclusions; while we are told that the main object of their manifestations is to furnish actual demonstration of the immortality of the soul and of some of the conditions and laws of the *post mortem* existence.—The books relating to spiritual manifestations may be reckoned by hundreds. The following are a few of the more important: J. Kerner, *Die Seherin von Prevorst* (Stuttgart, 1829; translated by Mrs. Crowe, London, 1845); Allan Kardec, *Le livre des esprits* (Paris, 1853), with a supplementary work, *Le livre des médiums* (1863), the first translated into English by Anna Blackwell under the title, "The Spirits' Book" (Boston, 1875), and the second by Emma A. Wood, "The Book of Mediums" (Boston, 1875); S. B. Brittan and B. W. Richmond, "A Discussion of the Facts and Philosophy of Ancient and Modern Spiritualism" (New York, 1853); John W. Edmonds and G. T. Dexter, "Spiritualism" (2 vols., New York, 1854–'5); Charles Linton, "The Healing of the Nations," with an introduction and appendix by N. P. Tallmadge (New York, 1855); Hudson Tuttle, "Scenes in the Spirit World, or Life in the Spheres" (New York, 1855); E. W. Capron, "Modern Spiritualism, its Facts and Fanaticisms" (Boston, 1855); Robert Hare, "Experimental Investigations of the Spirit Manifestations" (New York, 1856); Louis de Guldenstubbe, *La réalité des esprits et le phénomène merveilleux de l'écriture directe démontrés* (Paris, 1857); Catharine Crowe, "Spiritualism and the Age we Live in" (London, 1859); Robert Dale Owen, "Footfalls on the Boundary of Another World" (Philadelphia, 1860), and "The Debatable Land between this World and the Next" (New York, 1872); D. D. Home, "Incidents of my Life" (London, Paris, and New York, 1862; a second volume with the same title, 1872, and a third announced in 1875); Mrs. A. De Morgan, "From Matter to Spirit" (London, 1863); J. E. de Mirville, *Question des esprits et de leurs manifestations diverses* (Paris, 1863); William Howitt, "History of the Supernatural in all Ages and Nations" (London, 1863); C. W. Upham, "Salem Witchcraft, and a History of Opinions on Witchcraft and Kindred Subjects" (2 vols., Boston, 1867); Epes Sargent, "Planchette, or the Despair of Science" (Boston, 1869), and "The Proof Palpable of Immortality" (1875); Emma Hardinge, "Modern American Spiritualism" (New York, 1870); William Crookes, "Researches in the Phenomena of Spiritualism" (London, 1874); A. R. Wallace, "On Miracles and Modern Spiritualism, three Essays" (London, 1875); and H. S. Olcott, "People from the Other World" (Hartford, 1875). With the exception of these and a few other books, the best portion of the literature of spiritualism is to be found in the various periodicals devoted to that subject, the number of which in 1875, in Europe, America, and Australia, was at least 60.

**SPITZBERGEN**, a group of islands in the Arctic ocean, between lat. 76° 30′ and 80° 30′ N., and lon. 10° and 28° E., and nearly midway between Greenland on the west and Nova Zembla on the east; area estimated at 30,000 sq. m. The principal islands are Spitzbergen, Northeast land, Prince Charles, Edge, and Barentz. Spitzbergen proper, the largest of the islands, is nearly divided N. and S. by two arms of the sea, Weyde bay and Ice fiord, which stretch so far inland that their heads are separated by only a narrow peninsula 5

or 6 m. in breadth. The two divisions are sometimes called respectively West Spitzbergen and East Spitzbergen or New Friesland. E. of Spitzbergen lie Barentz island and Edge island (Russ. *Maloi Brun*), separated from it by a strait called Wybe Jans water, or by the Swedes Stor fiord. Between Edge and Barentz islands is Freeman or Thymen strait, and between Barentz island and Spitzbergen on the north Heley's sound. Hinlopen or Waygat strait separates Spitzbergen from Northeast land, so called from its relative position to the larger island. Its coast line is rugged and penetrated by numerous fiords, and it is surrounded by many islands, the principal of which are High island on the east, the group called the Seven islands on the north, and Low island on the west. Near the southern mouth of Hinlopen strait is Waygat or Wilhelm island, explored by Smyth in 1871. W. of Spitzbergen, and separated from it by Foreland strait, lies Prince Charles island or foreland. Little is known of the interior of Spitzbergen, but many mountains are visible from the coast, some of them 3,000 to 4,000 ft. high, the valleys of which are filled with glaciers. On the W. coast the mountains rise generally within 3 m. of the shore, leaving a level space between them and the sea. The N. shores are not so high, but inland the ice hills gradually rise to an elevation of more than 2,000 ft. Around the South cape or Point Lookout, the S. termination of Spitzbergen, the coast is flat, but it soon rises into a mountain chain which extends northward. The E. coasts have not been thoroughly explored. Spitzbergen feels the influence of two ocean currents flowing from nearly opposite directions: a polar current, which blocks up the E. and N. E. sides with ice and renders navigation dangerous, if not impossible; and a warmer Atlantic current, which flows up the W. coast and keeps it comparatively free from ice. The climate is intensely cold, the mean temperature on the W. coast during the three warmest months not exceeding 34·5°. The longest day in the N. parts is four months, and from Oct. 22 to Feb. 22 the sun does not rise above the horizon; but the long night is relieved by a faint twilight and the occasional brilliant light of the aurora borealis, and the moon and stars shine with great brightness. Winter begins at the end of September, and by the middle of October the cold is intense. Storms are frequent, and great quantities of snow fall. During the short summer the climate is temperate for the latitude, and a scanty vegetation springs up. About 40 species of plants have been classified, the most vigorous of which do not exceed 3 or 4 in. in height. The animals are polar bears, polar foxes, and reindeer. Sea fowl are numerous, and the surrounding waters abound with whales, seals, walruses, and large fish. Marble and coal of good quality have been found. These islands have been visited by whalers for 2½ centuries, and though there is no permanent settlement on any of them, Russian sailors have lived for years at a time on the W. coast. Their sovereignty is claimed by Russia.—Spitzbergen is supposed to have been first seen by Willoughby in 1553, in the voyage in which he perished with his crew. Barentz came in sight of the N. end of the W. coast, lat. 77° 49′, on June 19, 1596. He named it Greenland, and the Dutch navigators who followed him called it Nieuwland. By the English it was called King James's Newland. The name Spitzbergen (pointed mountains) first appears in a tract published by Hessel Gerard in 1613. Henry Hudson visited the N. and W. coasts in 1607, and soon after the seas around Spitzbergen became a favorite fishing ground for whalers, principally English and Dutch. In 1617 a ship of Capt. Edge's fleet explored the E. coast as far as lat. 79°, and discovered Wiche's land E. of Spitzbergen. This was renamed King Karl land in 1870 by Baron von Heuglin, who saw it from off Edge island and supposed he had made a new discovery. It was visited for the first time in 1872 by Nils Jansen, a Norwegian whaling captain. Important additions to our knowledge of Spitzbergen and its surroundings have been made by the Swedish expeditions under Nordenskjöld in 1858, '61, '64, '68, and '72; by B. Leigh Smyth and Ulve in 1871–'2; and by Altmann and Nilsen in 1872.

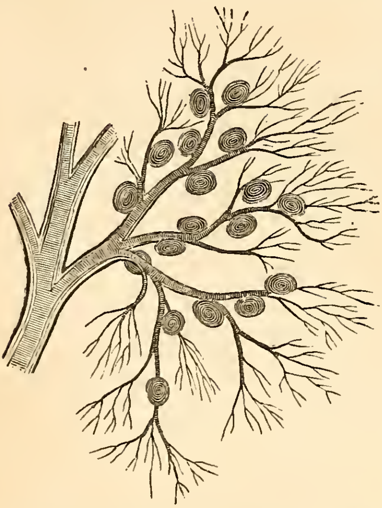
**SPITZ DOG**, a small variety of the Pomeranian dog. It is evidently derived from some of the arctic or wolf dogs, and resembles in its short, ovate, erect, and hairy ears, pointed muzzle, much-curved and bushy tail, the Esquimaux, Hare Indian, Siberian, Lapland, and Iceland dogs, though of smaller size and with finer and longer hair. The hair is long, espe-

Spitz Dog.

cially on the head and neck, and varying from pure white, which is most common, to cream color and occasionally jet-black. It is very active, intelligent, and handsome, an excellent watch dog, with many of the qualities of the shepherd's dog, and probably of the same ori-

gin. It is not improbable that it may have come from a cross between some of the smaller arctic wolf-like dogs and the arctic fox.

**SPLEEN** (Gr. σπλήν), the largest of the vascular or ductless glands, whose probable function is subsidiary to the process of sanguification. It is situated in the left hypochondriac region, below the diaphragm, above the descending colon, between the cartilages of the false ribs and the cardiac extremity of the stomach, to which it is united by short vessels. It is in health from 4 to 5 in. long, and $1\frac{1}{2}$ in. thick, of an elongated flattened form, and about 6 oz. in weight; on the inner surface is a longitudinal groove in which are the blood vessels, posteriorly resting on the vertebral column; below, it is in relation with the left kidney and capsule, and with the pancreas behind. It is soft and spongy, and dusky red.



A portion of the Splenic Artery, its ramifications being studded with Malpighian corpuscles (from the dog). (Magnified 10 diameters.)

Its external surface is covered with the peritoneum; beneath this is a coat of white fibrous tissue with some elastic fibres, from the inner surface of which extends through the entire organ a network of fibrous bands and threads, the trabecular tissue. The splenic artery comes from the cœliac axis, the trunks not anastomosing, but subdividing like the branches of a tree, to which the Malpighian corpuscles are attached as fruits on short peduncles, and ending generally in capillaries with very thin walls, passing in every direction through the organ and into the interior of the corpuscles. The veins are branched like the arteries, have no valves, and their principal stem is one of the trunks of the vena portæ; the nerves form the splenic plexus, and proceed from the solar plexus of the great sympathetic; the lymphatics are few and superficial. The parenchyma consists of a homogeneous mass of colorless nucleated corpuscles and cells imbedded in a granular plasma. The splenic corpuscles, or Malpighian bodies of the spleen, are whitish spherical bodies, about $\frac{1}{70}$ of an inch in diameter, attached to the smaller ramifications of the splenic artery. Each corpuscle consists of a closed sac or capsule, containing in its interior a viscid semi-solid mass of cells, cell nuclei, and homogeneous substance. Each Malpighian body is covered with a network of capillary blood vessels; and small blood vessels also penetrate into its interior, through the investing capsule, and form a vascular capillary plexus in the substance of the body itself.—The precise details of the function of the spleen are unknown. It belongs to the class of "ductless glands," that is, of organs having a glandular texture but no outlet or duct, and not supplying any distinct secretion like those of the glands proper. Their purpose undoubtedly is to effect some necessary change in the blood itself, producing in their glandular tissue some substance which is appropriated and carried away by the blood vessels distributed to them. Thus the veins of these organs are supposed to serve as their excretory ducts. The spleen, though so large, is not directly essential to life, and has been several times removed in the lower animals without an immediately fatal result. It is liable to acute and chronic enlargements in various forms of typhoid and intermittent fevers, and is sometimes excessively enlarged and solidified in the strumous diseases of infancy and childhood.

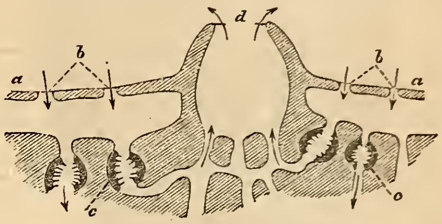
**SPOFFORD, Harriet Elizabeth** (PRESCOTT), an American authoress, born in Calais, Me., April 3, 1835. She was educated at Newburyport, Mass., and in 1865 married Richard S. Spofford of that place. She has published "Sir Rohan's Ghost" (1859); "The Amber Gods, and Other Stories" (1863); "Azarian, an Episode" (1864); "New England Legends" (1871); and "The Thief in the Night" (1872).

**SPOHR, Ludwig**, a German composer, born in Brunswick, April 5, 1784, died in Cassel, Oct. 22, 1859. He received instruction on the violin from Maucourt, and made his début at Brunswick at the age of 12, playing then a concerto of his own composition. At 18 he accompanied the violinist Eck to Russia. At 19 he composed the work since published as his first violin concerto (Opus 1). At 21 he made a tour through Germany, bringing out at one of his concerts the since celebrated composer Meyerbeer. In 1805 he was appointed chapelmaster at Gotha. In 1806 he married Dorothea Scheidler the harpist, and afterward composed many pieces for the harp in connection with the violin. In 1816 he visited Italy on a concert tour, and in 1817 he undertook the directorship of the Frankfort theatre. In 1820 he visited England, and conducted there the philharmonic society's concerts. In 1821 he was appointed chapelmaster at Cassel, where he resided during the remainder of his life. He brought out there his operas *Der Berggeist*,

*Jessonda*, and *Der Alchymist*, his oratorios *Die letzten Dinge* and *Des Heilands letzte Stunden* (known in the respective English versions as "The Last Judgment" and "The Crucifixion"), his symphony *Die Weihe der Töne* or "The Consecration of Tone," and other works. In 1852–'3 he directed the performances of his operas at the royal Italian opera house in London. In 1857 he resigned his office at Cassel. He exercised a decided influence upon the art of music both by his *Violinschule* (fol., Vienna, 1831) and by his compositions. Among these were nine spmphonies, eight operas, a great number of quartets and quintets for stringed instruments, and other chamber music.—See *Louis Spohr's Selbstbiographie* (2 vols., Göttingen, 1862), which has been translated into English.

**SPOLETO** (anc. *Spoletium*), a city of central Italy, formerly capital of a papal delegation of the same name, and since 1860 of a district in the province of Perugia (division of Umbria), on the Mareggia, 60 m. N. N. E. of Rome; pop. in 1872, 20,748. The streets are steep, the city being built around a hill; on the top of this is the citadel, which was built by Theodoric, destroyed by Totila, restored by Narses, and subsequently enlarged. Spoleto has a fine cathedral and many other churches, palaces, and relics of antiquity, including the arch known as the gate of Hannibal, who was repulsed here in 217 B. C. The chief articles of trade are maize, wine, fruit, and silk.—The ancient Spoletium was a flourishing Roman colony. After the fall of the western empire it was taken by the Goths. Under the Lombard kings it became the capital of a duchy, which soon acquired independence and authority over a considerable part of central Italy, and after various changes was in the 13th century annexed to the Roman see. The town was sacked by Frederick Barbarossa, and in 1324 devastated by the Perugians; and it has suffered much from earthquakes.

**SPONGE,** the common name applied to the order *spongida*, of the class of rhizopods, the most characteristic of the subkingdom *protozoa*. Sponges were for a long time regarded as plants, but the best naturalists are now agreed that they belong to the animal kingdom. Prof. H. J. Clark placed them nearest to the compound protozoans known as the flagellate infusoria, and it has been proved by him, and by others since, that the collar round the cilium must be regarded as the sponge animal; Kent classes them between the flagellate infusoria and the rhizopods; and Haeckel stands alone in placing them nearest to the corals or *cœlenterata*. (See "Annual and Magazine of Natural History," London, January, 1870.) A sponge is really an aggregation of separate masses of an amœba-like sarcode, secreting a supporting network of fibro-corneous, calcareous, or silicious matter, the compound mass being traversed by canals opening on the surface. The apparently homogeneous jelly, or sponge flesh, which covers the outside and lines the canals of the living sponge, is made up of an enormous number of sarcode masses, composed of separate sarcoids, each capable of pushing out its pseudopodia, generally with a vibrating cilium, and, if detached, able to move and live independently. Large rounded orifices, or *oscula*, are scattered over the surface of most sponges, which lead into sinuous canals permeating the substance in every direction; water is continually absorbed by the smaller pores of the sponge, filling every part, and, having supplied air and food, is




Diagrammatic Section of Spongilla (after Huxley).
*a a.* Outer or superficial layer of sponge. *b b.* Inhalant apertures, or pores. *c c.* Ciliated chambers. *d.* An exhalant aperture, or osculum. The arrows indicate the direction of the currents.

driven out through the oscula; the currents are kept up by the action of the minute vibratile cilia. In the words of Prof. Huxley, the sponge "represents a kind of subaqueous city, where the people are arranged about the streets and roads in such a manner that each can easily appropriate his food from the water as it passes along." Many sponges contain a large amount of silica, in the form of spicules of various shapes, both formed in their substance and introduced from without; two of the most beautiful of the silicious sponges will be found described under Glass Sponge and Venus's Flower Basket.—There is a gradual passage from the soft sponges of commerce to those of stiff and compact texture, with the fibres loaded with silicious spicula, crumbling easily when dry, and useless in the arts; others are rather of a felted character, usually grayish white. Sponges vary much in form, being irregularly branched, round, pear-shaped, or cup-like, and are fixed by a kind of root at the base, or incrust other bodies, growing mostly in groups attached to all kinds of objects, living or dead, fixed or floating; most are marine, but *spongilla* (Lam.) grows in fresh water; they often have brilliant colors. Some, like *cliona*, instead of incrusting other objects, excavate branching cavities in shells, which they inhabit. Sponges are propagated sometimes by ciliated gemmules, yellowish and oval, arising from the sarcode mass and carried out by the currents; they are mostly formed in the spring, and, after swimming freely about for some time, become fixed and grow. They also produce internal, unciliated, oviform bodies, resembling winter ova, which, when thrown out, swell, burst, and give issue to the locomo-

tive germs within; they are said also to grow by division, or growth of detached portions of the parent body; they are believed to be nourished by minute algæ drawn within their pores. Some live in shallow, others in very deep water; scarce and small in cold latitudes,

Sponge attached to its rocky bed.

they increase in size and number toward the tropics, being most abundant in the Australian seas. According to Dr. Bowerbank, there are 24 genera on the shores of Great Britain. While *spongia* is the type of the corneous sponges, *thethys* (Cuv.) and *Grantia* (Flem.) are types of the silicious and calcareous sponges respectively. (See Protozoa.)—For the latest researches on the sponges see the papers now in course of publication (1876) by Prof. A. Hyatt, in the "Memoirs of the Boston Society of Natural History," with figures and bibliography. Haeckel (*Monographie der Kalkschwämme*, 1872) regards the sponges and acalephs as having been evolved from a common ancestor, which he calls *protascus*, described as a body cavity surrounded by two layers of cells; he compares the sponge to the embryos of higher animals, both vertebrate and invertebrate. In his view, the germ of all animals, and the adult of such forms as hydra, may be reduced to the simple form of the young of a calcareous sponge, which he calls *gastrula;* this he considers the "truest and most significant embryonal form of the animal kingdom."—The sponges of commerce are procured chiefly in the Mediterranean and the Bahama islands; most of them are obtained by diving, to which persons are trained from childhood in the Greek islands; the adhesion to the bottom is generally firm, and the growth slow. To bleach sponges, the finest and softest are selected, washed several times in water, and immersed in very dilute hydrochloric acid to dissolve out the calcareous matters; having been again washed, they are placed in another bath of dilute hydrochloric acid to which 6 per cent. of hyposulphite of soda dissolved in a little warm water has been added; the sponge is left in this bath 24 hours, or until it is as white as snow. Smyrna is the chief place for the export of fine sponges. The coarse sponges used for horses and carriages, &c., are obtained chiefly from the Bahamas; when taken from the water they have a sickish, disagreeable odor, which soon becomes disgusting, like that of decomposing animal matter; they are first buried in dry sand, and when decomposition has ceased are exposed in wire cages to the action of the tide for purification.—Fossil sponges are found in the Trenton limestone, and, if *scolithus* be a mining sponge, even as low as the Potsdam sandstone, and probably were in existence long before the oldest Silurian epoch. *Brachiospongia*, discovered by the Rev. Mr. Hovey in the Birdseye group of the lower Silurian, is characterized by armlike processes radiating from a central cup. *Eospongia* of Billings has been found in the lowest Potsdam.

**SPONTANEOUS COMBUSTION.** See Combustion, Spontaneous.

**SPONTANEOUS GENERATION,** the direct production of living beings from inanimate material, in contradistinction to the ordinary mode of generation, in which young animals or plants appear only as the progeny of other living organisms. The views held by physiologists on the question of spontaneous generation have varied greatly at different times. In the earlier periods of scientific culture, the Grecian naturalists, as represented by Aristotle, recognized among animals three different modes of generation: 1, viviparous generation, as in man and the quadrupeds, where the young were known to be produced alive from the bodies of their parents; 2, oviparous generation, as in birds, reptiles, and fish, where the young were hatched from eggs produced by the female; 3, spontaneous generation, where no connection could be traced between the young animals and any previously existing parents, and where they were consequently thought to be formed by the spontaneous organization of earthy deposits or decaying organic material. Spontaneous generation was therefore regarded as one of the regular and natural methods for the production of living forms; but as a physiological doctrine it rested entirely upon negative grounds, and was due to the incomplete knowledge then possessed by naturalists as to the real origin of many animal species. Maggots, for instance, were thought to be formed by spontaneous genera-

tion from putrefying meat, because they always appeared at a certain stage of its decomposition, although no similar creatures existed in it beforehand, and because there was no other apparent cause for their production. A great change in opinion on this subject was introduced by the discoveries of Francesco Redi in 1668. He exposed fresh meat, during summer weather, in wide-mouthed bottles, protected by pieces of paper fastened over their necks. In the bottles thus secured no maggots were developed, notwithstanding that the putrefaction of the meat went on as usual; while in other similar vessels, unprotected by paper covers, maggots swarmed in abundance at the customary time. It was evident therefore that their origin was due to something introduced from without, and it soon appeared that they were really the progeny of flesh flies, which, attracted by the odor of the meat, hovered over it until they gained access to it, and deposited their eggs upon its surface. The eggs then hatched into maggots, which, after a certain period of growth, became transformed into perfect insects similar to their parents. The idea thus suggested was rapidly carried out by means of further observations on the reproduction and metamorphosis of insects in general. The investigations showed that in what had been supposed to be cases of spontaneous generation the animals were really produced from parents like themselves. The microscope soon brought into view many minute forms of life not previously known. The multiplicity of these forms, their endless variation, their small size, and their different conditions of life made it impossible at first to ascertain their complete physiological history or their mode of origin; and in regard to many of them the idea of spontaneous generation was again adopted. This was especially the case with the class known as *infusoria;* that is, microscopic animals living in water or in watery infusions of organic material, some of the smallest of which received the name of monads. Investigations upon this point were consequently taken up afresh, with a view of determining whether the infusoria in a watery liquid were produced by the ingredients of the solution itself, or by germs derived from without. Experimenters boiled the watery infusions, to destroy the vitality of any animalcules or germs which they might already contain, and afterward kept them, with a due supply of air, in hermetically sealed flasks. If, under these circumstances, living forms still made their appearance in the infusions, they must be attributed to spontaneous generation; if not, they must be regarded as dependent on the preëxistence or introduction of germs. These experiments were tried by different observers, with results which varied according to the nature and extent of the precautions adopted; but the general conclusion, derived especially from the investigations of Spallanzani in 1775, was that a preliminary boiling in closed flasks, for a few minutes, effectually prevented the appearance of all the larger and more highly organized infusoria; while, if the boiling were prolonged from half an hour to an hour, the infusion afterward remained absolutely destitute of all forms of life, even the smallest and simplest. Although at that time the real mode of generation of the infusoria had never been ascertained, nor their eggs detected by the microscope, it was considered certain that these animalcules must require for their production the existence of living germs, and consequently that they did not originate by spontaneous generation. During the early and middle part of the present century the common opinion of naturalists became gradually more decided in opposition to the doctrine of spontaneous generation, owing to the occasional repetition of experiments like Spallanzani's, and also to important discoveries in regard to the sexless internal parasites, such as *cysticercus* and *trichina.* These creatures were found inhabiting the solid tissues of other animals, and furthermore were seen to be incapable of exercising the function of generation. It was difficult therefore to account for their presence in the animal tissues unless by a growth upon the spot, and also to understand how the species could be reproduced by ordinary modes of generation. But continued investigation removed both of these difficulties. It was shown by the researches of Siebold, Küchenmeister, Leuckart, Pagenstecher, and others, that the sexless parasites were in reality the embryonic or youthful progeny of perfectly developed parents; their mode of introduction into the internal cavities and tissues of the body was ascertained; and they were found to acquire after a time sexual organs, and to produce a new progeny by sexual generation. Thus, one by one, a great variety of obscure animal species became more perfectly known; and a complete study of their physiological history revealed in every instance the regular mode of their origin and reproduction. But the class of infusoria still remained somewhat refractory in this respect, and notwithstanding that the question had been for some years regarded as settled, it was reopened in 1858. M. Pouchet, an eminent naturalist and physiologist of Rouen, took the ground that the former experiments in regard to boiled infusions were incorrect, and that in point of fact a preliminary boiling did not prevent the appearance of infusorial life. Pouchet's views and assertions were supported by the testimony of several other experimenters, among the most distinguished of whom have been Mantegazza and Bastian. They were opposed by many others, of equal reputation; and the weight of the discussion turned for a time upon the dissemination of germs in the atmosphere, as the supposed source of life in organic infusions. The most important experiments in this direction were those of Pasteur, from 1860 to 1865. This chemist had been espe-

cially interested in the study of fermentation, which was shown to be a change dependent on the presence and growth of microscopic vegetable cells. He boiled a suitable organic infusion in glass flasks, the necks of which were drawn out and sealed while ebullition was going on, thus excluding completely the atmospheric air. Afterward, when the flask and its contents had become cooled, the air was readmitted through the neck of the flask, by breaking off its narrow end. But this operation was done, with different sets of flasks, in different localities, in order to determine whether the difference of locality had any influence upon the subsequent appearance or non-appearance of life within the flask. The bearing of these experiments upon the question at issue was as follows. If it were the constituent gases of the atmosphere alone which excited the spontaneous growth of living forms by the necessary supply of oxygen, then the production of these forms should follow with the same readiness in all localities, because the gaseous constitution of the atmosphere is everywhere the same. But if, in order to produce life, the atmosphere must also bring with it certain organic germs, then the locality might make a difference in the result, because these floating particles would naturally vary in abundance in different regions. Investigation showed a manifest difference, according to the place where the air was admitted to the flask. In one of the most significant of Pasteur's experiments, a flask containing an organic infusion was boiled, sealed, allowed to cool, and afterward carried to the valley of Chamouni in Savoy, where its neck was opened and the air admitted on the Montanvert, 6,000 ft. above the sea level. It was immediately resealed, brought back to Paris, and kept for four years perfectly unchanged. It was then reopened and again exposed to the air, and in three days afterward contained a growth of microscopic vegetation. These experiments were considered by Pasteur and his associates as demonstrating the existence in the atmosphere of extraneous particles, the introduction of which into an infusion was the necessary condition of infusorial life. A further difficulty now began to be appreciated in this method of investigation. It had at first been taken for granted that a boiling temperature would necessarily destroy the vitality of both the infusoria and their germs. But this gradually became a matter of doubt, especially as the length of time during which the boiling was continued evidently had an influence on the subsequent appearance of life in the infusion. It was found necessary to determine more exactly the limits of this influence; and among the most valuable experiments in that respect were those of Jeffries Wyman in 1867. He showed that, in infusions of a certain constitution, the minute forms known as *bacteria* might appear in closed flasks after boiling; that the longer the boiling was continued, the fewer the instances in which bacteria were afterward developed; and that they never made their appearance in infusions which had been boiled continuously for five or six hours. These results were variously interpreted by different observers; a certain number still maintaining that bacteria might often be developed after the application of a heat sufficient to destroy their previous vitality.—In the modern renewal of the question of spontaneous generation, dating from Pouchet in 1858, another element has had its influence upon this discussion; that is, the idea of evolution, as accounting for the present existence of organic life upon the earth. It is assumed that there was once a period in the history of the earth when, from its elevated temperature and the different combination of its chemical elements, life could not possibly exist upon it; that, as living beings subsequently made their appearance, they must necessarily have originated by the spontaneous organization of inanimate materials; and that these primitive and imperfect structures have gradually, by modification and descent, given rise to all the forms of animal and vegetable life now inhabiting the globe. Some of those who accept the evolution doctrines believe that the conditions necessary for a spontaneous production of life have long since passed away, with the earlier stages of the world's history; others maintain that these conditions still exist, and are effective for the continued creation of bacteria and their allied forms. It is common to meet with expressions, among writers of this class, which declare that spontaneous generation is not so much a matter of question or experiment as a logical sequence of the doctrine of evolution. The stricter school of physiologists maintain, on the contrary, that it is a subject to be investigated on its own merits, by means of observation and experiment, like any other question relating to the phenomena of life.—Of late years the experimental evidence bearing on this topio has received an important addition from the independent researches of naturalists in regard to the infusoria. Some of the forms originally included in this group have been found, on more extended examination, to possess a higher organization, and have been by common consent transferred to the class of worms. Like others of this class, they reproduce their species by sexual generation, and often contain living embryos in the interior of their bodies. The infusoria proper are now known to be mostly ciliated animalcules; that is, they are provided with minute, vibrating, hair-like appendages, by which they perform rapid movements of locomotion. They have also been shown, principally by the labors of Stein, Balbiani, Engelmann, and Claparède and Lachmann, to perform the act of sexual generation, and to produce their young by means of fertile eggs, from which embryos are developed. The more minute and lowly forms, on the other hand, usually included under the general term bacteria, do not belong to the animal kingdom,

but are microscopic vegetables. They have a remarkable power of multiplication by division or doubling of their cells; and certain species appear to be the active agents in causing the putrefactive decomposition of albuminoid organic substances. The more modern investigations on spontaneous generation with boiled infusions have been almost exclusively confined to this class. But even in bacteria there are indications of a reproduction by germs. Cohn in 1872 observed certain bodies in connection with bacteria, which he regarded as resting spores; that is, spores which do not immediately germinate, but remain quiescent for a certain interval and afterward become developed under other conditions. These resting spores were more fully described in 1874 by Billroth, whose description has been confirmed by Stimson in 1875. According to Billroth, although the vitality of bacteria is destroyed by boiling, their resting spores will withstand this temperature, and are afterward capable of development into active forms. This may explain the occasional appearance of microscopic life in organic solutions which have been subjected to ebullition.—For the most complete recent defence of the doctrine of spontaneous generation, see "The Beginnings of Life," by H. Charlton Bastian, F. R. S. (2 vols., London and New York, 1872).

**SPONTINI, Gasparo Luigi Pacifico,** an Italian composer, born at Majolati, near Ancona, Nov. 14, 1774, died there, Jan. 24, 1851. At the age of 13 he entered the conservatory of La Pietà at Naples, and was for a time a teacher there. In 1796 he produced *I puntigli delle donne*, which was followed during the succeeding 10 years by 12 other operas, tragic and comic. In 1803 he went to Paris, where his first great work, *La Vestale*, was brought out in December, 1807, and at once established his reputation throughout Europe. It was succeeded in 1809 by another work of equal vigor, *Fernando Cortez.* The success of these works obtained for Spontini in 1810 the directorship of the Italian opera. He accepted the post of director general of music at the court of Prussia in 1820, and remained at Berlin for 22 years. In 1842 he returned to Paris, and near the close of his life resumed his residence in his native village. He received the title of count of Sant' Andrea from the pope, and that of doctor of philosophy and arts from the university of Halle, and was made a member of the French institute.

**SPOONBILL,** the common name of the wading birds of the family *plataleidæ*, characterized by a much depressed bill, very broad, and dilated at the end in the shape of a rounded spoon. In the genus *platalea* (Linn.) the bill is long, straight, thin, slightly bent downward at the tip, the mandibles in close opposition and the edges not lamellar; nostrils basal and in the lateral groove; wings long, second quill the longest; tail short; legs longer than in the typical waders, tibia bare for nearly one half; tarsi not much longer than middle toe, covered with small hexagonal scales; toes webbed at the base, the outer longer than the inner, the middle not pectinated, and the hind one only partly resting on the ground; claws short and obtuse. There are about a half dozen species, found in all quarters of the globe, migrating to warm climates at the approach of winter; they frequent marshy inlets of the sea, and the borders of lakes and rivers, wading about in search of fish fry, worms, frogs, and aquatic insects; they can swim and dive. The nest is made either on trees or among rushes in swampy places, and composed of coarse sticks; the eggs are two to four, whitish. The roseate spoonbill (*P. ajaja*, Linn.) is about 30 in. long, and $4\frac{1}{3}$ ft. in alar extent; the bill is 7 in. and covered with a soft skin; the head is of moderate size, bare, the skin yellowish green; the neck is long and slender, and the body compact and muscular. The prevailing color is rosy red, paler in front, and nearly white on the neck; lesser wing coverts, upper and lower tail coverts, and lower part of throat, bright carmine; tail feathers ochrey yellow; the young have the head feathered, the carmine tint wanting, and the tail rosy. It is found in the southern Atlantic and gulf states, and is very abundant in the breeding season on Indian river, Florida; it does not go above North Carolina, nor far from the sea. These birds are essentially nocturnal, though they often feed by day when the tide suits; they are fond of the company of herons; they fly with the neck and legs extended, and rise rapidly to a great height; they alight easily on trees, and can walk on the large branches. The breeding time in the Florida keys begins in February, the young

European Spoonbill (Platalea leucorodia).

being out of the nest by April 1; the nest is usually in the top of a mangrove, coarsely made; the eggs are commonly three, elongated, $2\frac{1}{2}$ by $1\frac{1}{2}$ in., white, sprinkled all over with

bright rufous spots, forming a ring near the large end; they breed and are commonly seen in flocks. The flesh is oily and poor eating; the beautiful feathers of the wings are made into fans in Florida. The European spoonbill (*P. leucorodia*, Linn.) is about the same size, white with reddish yellow patch on breast, pale yellow naked space around eyes and throat, and a yellowish white, long occipital crest; it is rare in England, but common in Holland and S. Europe and all over Africa.

**SPORADES** (Gr., the scattered), the lesser islands of the Grecian archipelago surrounding the group of the Cyclades, divided into the northern, western, and eastern Sporades. The northern group includes the islands of Skiatho (in antiquity Sciathus), Scopelos, Khilidromi (probably Icus), and Skyros; these lie off the N. E. coast of Negropont or Eubœa, and belong to the kingdom of Greece. The western group, which also belongs to Greece, lies off the E. coast of Argolis, and includes Hydra (Hydrea), Spezzia (Tiparenos), Poros (Calauria), Ægina, and Kuluri (Salamis). The eastern group belongs to Turkey, and lies off the S. W. coast of Asia Minor; it includes Psara or Ipsara (Psyra), Scio (Chios), Samos, Nikaria (Icarus or Icaria), Patmos, Leros, Calymno (Calymna), Stanko (Cos), Stampalia or Astropalia (Astypalæa), and Scarpanto (Carpathus). The Sporades of the ancients included only the eastern group, and this with the exception of the northernmost islands.

**SPOTSWOOD, John**, a Scottish prelate, born in Edinburghshire in 1565, died in London, Nov. 26, 1639. He graduated at the university of Glasgow at the age of 16, and at 20 succeeded his father as minister of Calderkirk. At first he strenuously opposed episcopacy, but soon yielding to the court party, he began to favor it in a moderate form. In 1603 he was one of five clergymen selected by James I. to accompany him to London for his coronation, and while there was appointed to succeed Beatoun as archbishop of Glasgow. From this time he earnestly sought to establish episcopacy in Scotland, incurring much odium among the great body of the Scottish people. In 1609 he was appointed an extraordinary lord of session, but was obliged to remain subject to the ordinary church courts till 1610, when he and two other Scottish bishops received episcopal ordination at the hands of English bishops. He became primate of all Scotland in 1615, and in 1633 placed the crown on the head of Charles I. as king of Scotland. He had for some years been the head, first of one of the two courts of high commission for trying offences against the church, and then of the two combined; and in 1635 he was appointed lord high chancellor of Scotland. Contrary to his own inclinations, as alleged, but by order of the king, he introduced a new liturgy and book of canons, which so aroused Scottish indignation that he retired in 1637 to Newcastle, and finally to London. He wrote a "History of the Church of Scotland, from the Year 203 to the Close of the Reign of James VI." (fol., London, 1655), and one or two smaller works.

**SPOTTED FEVER.** See Fevers, vol. vii., p. 168.

**SPOTTSYLVANIA**, an E. county of Virginia, bounded N. E. by the Rappahannock and S. W. by the North Anna river, and drained by the Mattapony; area, about 450 sq. m.; pop. in 1870, 11,728, of whom 4,659 were colored. The surface is hilly and the soil fertile. Granite and freestone are abundant. It is intersected by the Rappahannock canal and the Richmond, Fredericksburg, and Potomac railroad. The chief productions in 1870 were 56,050 bushels of wheat, 104,210 of Indian corn, 50,832 of oats, 132,502 lbs. of tobacco, 4,527 of wool, and 30,678 of butter. There were 906 horses, 1,388 milch cows, 1,684 other cattle, 1,928 sheep, and 3,662 swine. Capital, Spottsylvania Court House.

**SPOTTSYLVANIA COURT HOUSE, Battles at.** See Wilderness.

**SPRAGUE, Charles**, an American poet, born in Boston, Oct. 26, 1791, died there, Jan. 14, 1875. At the age of 13 he entered a mercantile house as clerk, and subsequently became a partner. In 1820 he became teller in the State bank; and in 1825, on the establishment of the Globe bank, he was appointed its cashier, an office which he held till 1865. From 1821 to 1830 he gained five prizes for prologues to be recited at the opening of theatres in New York, Philadelphia, Salem, and Portsmouth. In 1823 he obtained the prize for the best ode to be recited at the exhibition at the Boston theatre of a pageant in honor of Shakespeare; and in 1830 he pronounced an ode at the centennial celebration of the settlement of Boston. In 1829 he delivered a poem on "Curiosity" before the Phi Beta Kappa society in Cambridge, considered his best production. A collection of his writings was published in New York (1841; new ed., 1850), and a complete revised collection in Boston (1850; new ed., 1855).

**SPRAGUE, William Buell**, an American clergyman, born in Andover, Conn., Oct. 16, 1795, died in Flushing, N. Y., May 7, 1876. He graduated at Yale college in 1815, studied in the theological seminary at Princeton, and in August, 1819, was ordained pastor of the first Congregational church at West Springfield, Mass., as a colleague of the Rev. Joseph Lathrop, whom he succeeded as pastor in 1820. In 1829 he was installed pastor of the second Presbyterian church at Albany, N. Y. He resigned this charge in 1869, and removed to Flushing, N. Y. He made large collections of pamphlets and autographs, the former of which he presented in 1875 to the state library at Albany. He published "Letters to a Daughter" (1822), republished under the title "The Daughter's Own Book;" "Letters from Europe" (1828); "Lectures to Young People" (1830); "Lectures on Revivals of Re-

ligion" (1832); "Hints on Christian Intercourse" (1834); "Lectures illustrating the Contrast between true Christianity and various other Systems" (1837); "Life of E. D. Griffin" (1838); "Life of Timothy Dwight, D. D., President of Yale College," in Sparks's "American Biography" (1845); "Letters to Young Men, founded on the History of Joseph" (2d ed., 1845); "Aids to Early Religion" (1847); "Words to a Young Man's Conscience" (1848); "Women of the Bible" (1850); "Visits to European Celebrities" (1855); "Annals of the American Pulpit," a collection of biographies of leading clergymen of all the denominations (9 vols. 8vo, New York, 1856–'69); and "Memoirs of Rev. John and W. A. M'Dowell, D. D." (1864).

**SPRAT,** a small fish of the herring family, and genus *harengula* (Val.). There are teeth on the jaws, tongue, palate, and pterygoid bones, but none on the vomer; the branchiostegal rays are six or seven. There are about ten species, of which the most common is the English sprat (*H. sprattus*, Val.), called garvie in Scotland; it is 5 or 6 in. long, with the body proportionately deeper than in the herring, and the edge of the abdomen strongly serrated; the scales are large, round, and deciduous; the upper part of head and back dark blue, with green reflections, passing into silvery white on the gill covers, sides, and abdomen; dorsal and caudal dusky, other fins white. It is found on the coasts of Great Britain and Sweden; it ascends the rivers in large shoals in November, after the herrings have disappeared. Though smaller than the herring, it furnishes in winter an abundant, cheap, and wholesome food, and is generally eaten fresh. The fishery is prosecuted by drift or stationary nets, and with most success in dark and foggy nights. Several species in the West Indian seas are called sardines.

**SPRAT, Thomas,** an English prelate, born at Tallaton, Devonshire, in 1636, died at Bromley, Kent, May 30, 1713. He was educated at Oxford, and became chaplain first to the duke of Buckingham, and afterward to Charles II. In 1668 he was made prebendary of Westminster, in 1680 canon of Windsor, in 1683 dean of Westminster, and in 1684 bishop of Rochester. He was clerk of the closet to James II., and in 1686 was made one of the commissioners for ecclesiastical affairs. He published "The Plague of Athens" and "The Death of Oliver Cromwell," poems (1659); "The History of the Royal Society," of which he was one of the original fellows (1677); a history of the Rye House plot (1685); and a volume of sermons (1710); and he edited Cowley's "Poems," with a life in Latin (1668), afterward in English with additions.

**SPRENGEL, Kurt,** a German physician, born at Boldekow, Prussia, Aug. 3, 1766, died in Halle, March 15, 1833. He took his degree at Halle in 1787, and became professor there of medicine, and in 1797 also of botany. His works include *Versuch einer pragmatischen Geschichte der Arzneikunde* (5 vols., Halle, 1792–1803; 3d ed., 1821–'8; 4th ed. by Rosenbaum, 1846 *et seq.*); *Handbuch der Pathologie* (3 vols., Leipsic, 1795–'7; 4th ed., 1815); *Institutiones Medicæ* (6 vols., 1809–'16; new ed. of the last 5 vols., 1819); *Historia Rei Herbariæ* (2 vols., Amsterdam, 1807–'8); *Geschichte der Botanik* (2 vols., Altona and Leipsic, 1817–'18); and *Neue Entdeckungen im ganzen Umfange der Pflanzenkunde* (3 vols., 1819–'22).

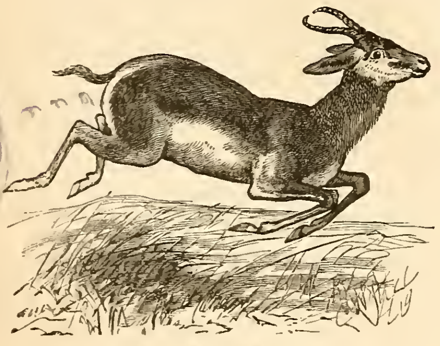
**SPRENGER, Aloys,** a German orientalist, born at Nassereut, Tyrol, Sept. 3, 1813. After studying at Vienna, he went in 1836 to London, where he assisted the earl of Munster in his work on the "Military Science of the Mohammedan Nations." He joined the East India service, in 1845 became president of the college of Delhi, and in 1850 examiner at the college of Fort William, Calcutta, government interpreter, and secretary of the Asiatic society. He published in the *Bibliotheca Indica* translations from the Arabic and Persian, besides works in the Urdu dialect, and a "Life of Mohammed" (vol. i., Allahabad, 1851). He returned to Europe in 1857, became professor of oriental languages in Bonn, and published *Das Leben und die Lehre des Mohamad* (3 vols., Berlin, 1861–'5; 2d ed., 1868 *et seq.*).

**SPRING,** in astronomy, one of the four seasons of the year, beginning for the northern hemisphere at the time of the vernal equinox, or on March 21, and ending at the time of the summer solstice, or June 21. In the United States the spring is regarded as including March, April, and May. (See SEASONS.)

**SPRING. I. Samuel,** an American clergyman, born at Northbridge, Mass., Feb. 27, 1746, died in Newburyport, March 4, 1819. He graduated at Princeton college in 1771, and in 1775 became a chaplain in the continental army, and accompanied the expedition under Col. Arnold to Canada. In 1777 he was ordained pastor of a church in Newburyport. He was a man of great influence and weight of character, and as the leading minister of the Hopkinsian party was active in promoting the union of the two parties in the Congregational churches, effected by the establishment of the Andover theological seminary, and also in originating the American board of commissioners for foreign missions. **II. Gardiner,** an American clergyman, son of the preceding, born in Newburyport, Mass., Feb. 24, 1785, died in New York, Aug. 18, 1873. He graduated at Yale college in 1805, and taught and studied in Bermuda nearly two years. After his return he was admitted to the bar in December, 1808, and practised more than a year. He then studied at Andover seminary, and was ordained as pastor of the Brick church (Presbyterian) in Beekman street, New York, Aug. 10, 1810, in which office he continued till his death. In 1856 he removed with his congregation to the new church on Murray hill. During the last years of his life Dr. Spring seldom preached, his place being filled

by an assistant. His works, chiefly courses of sermons and lectures, are: "Essays on the Distinguishing Traits of Christian Character" (1813); "Fragments from the Study of a Pastor" (1838); "Obligations of the World to the Bible" (1844); "The Attraction of the Cross" (1845); "The Bible not of Man" (1847); "Discourses to Seamen" (1847); "The Power of the Pulpit" (1848); "The Mercy Seat" (1849); "First Things" (2 vols. 8vo, 1851); "The Glory of Christ" (2 vols., 1852); "Contrast between Good and Bad Men" (2 vols., 1855); "Pulpit Ministrations" (2 vols., 1864); and "Personal Reminiscences of the Life and Times of Gardiner Spring" (2 vols., 1866).

**SPRINGBOK** (*antidorcas euchore*), a true antelope of the fields, coming near the gazelles in size and habits, so named from the extraordinary leaps of 7 to 10 ft. in height which it makes when alarmed. They wander in search of food in immense herds over the vast open plains of S. Africa, an easy prey to man and the carnivora. The general color is cinnamon brown above, white below, with



Springbok (Antidorcas euchore).

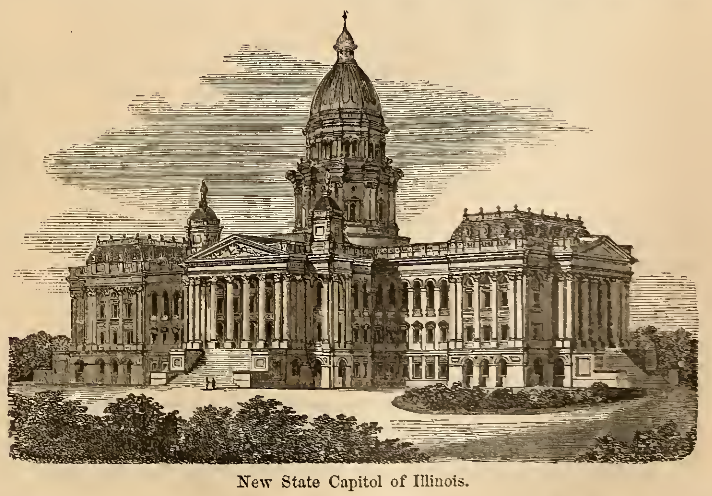
long white hairs on the croup very conspicuous when jumping; its flesh and skin are much esteemed. The horns in the adult are lyrate.

**SPRINGFIELD,** a city and the shire town of Hampden co., Massachusetts, on the E. bank of Connecticut river, opposite the town of West Springfield, with which it is connected by a railroad and a highway bridge and by ferry, 80 m. W. by S. of Boston, and 120 m. N. N. E. of New York; pop. in 1850, 11,766; in 1860, 15,199; in 1870, 26,703, of whom 6,930 were foreigners; in 1875, 31,053. It is noted for the great variety of its skilled industries, mostly dependent on steam power, and for the richness of its churches, of which five are built of stone and are of considerable architectural merit. Portions of the city are elevated and hilly, but along the river it is level. It is well built, and has wide streets shaded with elms and maples. The city hall is a noble building in the Romanesque style, and has a large public hall which will accommodate 2,700 persons. There are several other public halls, of which the music hall, seating 1,200, is the largest. The court house is a fine granite building, which cost $200,000. The city library contains 36,500 volumes. The new library building is one of the handsomest public edifices in the city. It is of brick, with facings of granite and Ohio stone, and cost with land about $100,000. Besides the library it contains a museum of natural history and antiquities. The new high school building is a fine structure of pressed brick, with trimmings of gray Ohio sandstone, three stories above the basement. Hampden park, on the bank of the Connecticut, contains 60 acres, with a costly dike to protect it from the spring freshets, and has a celebrated race course. The Springfield cemetery contains about 40 acres, with a great variety of shade trees and fountains. Springfield is an important railroad centre, four lines meeting in one large depot, each having extensive connections, viz.: the Boston and Albany, the New Haven, Hartford, and Springfield, the Connecticut River, and the Springfield, Athol, and Northeastern. The United States armory employs from 500 to 700 men, chiefly in the manufacture of rifles and carbines. During the civil war about 3,000 men were employed. The arsenal, offices, storehouses, and principal shops occupy nearly the highest ground in the city, on State street, and command a fine view of the Connecticut valley. The grounds (72 acres) are enclosed with an iron fence and beautifully laid out with trees, shrubbery, and flowers. The arsenal contains about 275,000 stand of arms. The heavier work is done at the shops on Mill river. The germ of the armory existed during the revolution, but it was not formally established till 1794. Among the more important private manufactories are one of railroad cars, one of sporting arms, one of revolvers, several of steam engines, boilers, &c., two of gold chains, one of gold leaf, one of gold rings, three of buttons, two of card and glazed paper, one of blankets, one of cartridges, two of desks and counters, three of elevators, four of envelopes, one of corrugated iron, one of filters, several of furniture, three of hand stamps, four of hardware, one of gas machines, one of gilt moulding, several of harness, saddlery, and trunks, one of levels, two of mattresses, one of sewing machine needles, one of paint, three of paper boxes, one of collar paper, three of paper collars, two of rubber goods, one of sieves, two of show cases, one of skates, two of slippers, one of spectacles and thimbles, two of steam pumps, one of watches, one of woollens, five of brick, and one of boots and shoes, two cotton mills, and two brass founderies. The Morgan envelope company also manufacture fancy stationery and writing materials, and print the postal cards for the government. There are five book-publishing houses; eight national banks, with an aggregate capital of $2,950,000; three savings banks, with deposits to the amount of $8,500,000; and three insurance companies (two fire and one life). The city is divided into eight wards, and is governed by a mayor, a board of

aldermen of one member from each ward, and a common council of 18 members. Water is supplied by works recently erected, there being three reservoirs for low service, with an aggregate capacity of 110,577,000 gallons, and one for high service, with a capacity of 2,132,-817,000 gallons. The expenditures in 1874 amounted to $781,847, viz.: pauper department, $23,153 17; highways, $117,310 83; salaries, &c., $110,118 79; erection and repair of school houses, $81,849 78; fire department, $35,735 55; interest, $58,742 77; police, $29,046 63; sewers, $45,004 80; miscellaneous, $228,815 30. The valuation of property was $38,336,778; interest-bearing debt at the close of the year, $1,794,875. The principal charitable institutions are the almshouse, city hospital, home for women, and home for children. The public schools are under the general management of a committee of one member from each ward, and under the immediate supervision of a superintendent. In 1873-'4 there were 26 school houses, with a high school, 140 teachers, and an average attendance of about 4,000; current expenses, $110,185 79, of which $85,593 41 were for teachers' wages. Two newspapers with daily and weekly editions and two weeklies are published. There are 26 churches, viz.: 1 Adventist, 3 Baptist, 6 Congregational, 1 Episcopal, 5 Methodist, 5 Roman Catholic, 1 Spiritualist, 1 Swedenborgian, 1 Union Evangelical, 1 Unitarian, and 1 Universalist.—Springfield was first settled in 1635 by emigrants from Roxbury, who on May 14 drew up and signed an agreement for self-government. The place was first named Agawam, the Indian name of a river of West Springfield, which with several adjacent towns of the present day was then included in its boundaries. In 1637 a church was formed. In 1638 the settlers chose William Pynchon magistrate, and in April of the same year named the settlement Springfield, from the name of his residence in England. Mr. Pynchon returned to England in 1652; but his son John remained, and in 1662 erected the famous "Pynchon house," the first brick house in the Connecticut valley, and long a fortress against the Indians. In 1675, during King Philip's war, the Indians burned the settlement, destroying about 30 houses and 25 barns. The growth of the town was slow till the opening of the Boston and Albany railroad in 1838. It was made a city in 1852.

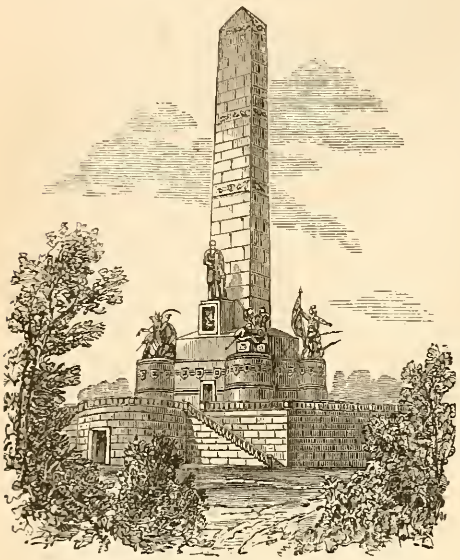
**SPRINGFIELD,** a city and the capital of Clark co., Ohio, at the junction of Lagonda creek with Mad river, 45 m. W. of Columbus and 70 m. N. E. of Cincinnati; pop. in 1850, 5,108; in 1860, 7,002; in 1870, 12,652, of whom 2,169 were foreigners. It is in the heart of one of the richest and most populous agricultural regions in the Union, and is well laid out and handsomely built. Six lines of railroad intersect here, viz.: the Cleveland, Columbus, Cincinnati, and Indianapolis; Cleveland, Sandusky, and Cincinnati; Columbus, Springfield, and Cincinnati; Little Miami (Springfield branch); Springfield and Jackson (narrow-gauge coal road); and Atlantic and Great Western. A large trade is carried on in wheat, flour, Indian corn, and other produce, and many cattle and swine are shipped to eastern markets. Water power is abundant, and about 80 factories are in operation, employing 4,000 hands. These include flouring mills, iron founderies, machine shops, manufactories of agricultural implements, linseed oil mills, and a paper mill. More than 30,000 mowers and reapers are manufactured annually. Limestone is largely quarried and burned. Four national banks have an aggregate capital of $900,000. There are six large public school buildings, including a fine new high school house. The Springfield seminary is a flourishing institution. Wittenberg college, under the auspices of the Evangelical Lutheran church, was opened in 1845; in 1874-'5 it had 10 instructors, 163 students (100 in the collegiate department), and a library of 6,000 volumes. Springfield has a free public library of 4,000 volumes, a daily, a tri-weekly, and five weekly newspapers, two monthly periodicals, and 20 churches.

**SPRINGFIELD,** a city and the capital of Illinois, and seat of justice of Sangamon co., 178 m. S. W. of Chicago; lat. 39° 48′ N., lon. 89° 33′ W.; pop. in 1840, 2,579; in 1850, 4,533; in



New State Capitol of Illinois.

1860, 9,320; in 1870, 17,364, of whom 4,456 were foreigners; in 1875, 25,116. It is on a beautiful prairie, 5 m. S. of Sangamon river. Its streets are broad, intersect each other at right angles, and are tastefully adorned with shade trees. From the beauty of the place



Lincoln Monument.

and its surroundings, it is termed the "Flower City." The capitol, in a square near the centre of the city, is one of the finest buildings of the kind in the country. Other noteworthy buildings are the United States court house and custom house and post office building, the county court house, state arsenal, high school house, and several handsome churches and commodious hotels. A new state house is nearly completed. Two miles N. of the city is Oak Ridge cemetery, a picturesque and well kept burying ground of 72 acres, containing the remains of Lincoln and a monument to his memory which cost $206,550, dedicated on Oct. 15, 1874. Springfield is the point of intersection of the Springfield and Northwestern, the Gilman, Clinton, and Springfield, the Ohio and Mississippi, the Chicago, Alton, and St. Louis, and the Toledo, Wabash, and Western railroad lines. There are coal mines in the vicinity, and the surrounding country is very productive. The trade is extensive, and the manufactures are important. The principal establishments are flouring mills, founderies and machine shops, rolling mills, breweries, woollen mills, a watch factory, and manufactories of woodwork, brooms, cordage, harness and saddlery, carriages and wagons, furniture, washing machines, and sash, doors, and blinds. There are three national banks, a private bank, a savings institution, and an insurance company. The city is governed by a mayor and 18 aldermen (3 from each ward). It is supplied with water from Sangamon river. It contains three academies and five public schools (one high and four ward schools), the latter having in 1874-'5 2,530 pupils enrolled, and an average attendance of 1,876. There are two daily and four weekly (one German) newspapers, a library association, and 22 churches, viz.: 4 Baptist, 1 Christian, 1 Congregational, 2 Episcopal, 1 Jewish, 3 Lutheran, 4 Methodist, 4 Presbyterian, and 2 Roman Catholic.—Springfield was laid out in 1822, was made the state capital in 1837, and a city in 1840.

**SPRINGFIELD**, a town and the county seat of Greene co., Missouri, on Wilson creek and the Atlantic and Pacific railroad, 195 m. in direct line S. W. of St. Louis; pop. in 1870, 5,555, of whom 1,090 were colored; in 1875, about 8,000. It is on a table land 1,500 ft. higher than St. Louis. Its trade and manufactures are important. The principal establishments are four flouring mills, two planing mills, a cotton mill, a woollen mill, a carriage factory, two iron establishments, two wagon factories, and the railroad shops. There are two hotels, two national banks, good public schools, a daily and four weekly newspapers, and 13 churches. It is the seat of Drury college (Congregational), founded in 1873.—Springfield was known as an Indian trading post and frontier village as early as 1820. It was incorporated in 1830. Its prosperity dates from the close of the civil war. In the autumn of 1861 and the early part of 1862 it was alternately in the possession of the federal and the confederate forces; and several fights occurred in the town and its vicinity, in one of which (Aug. 10, 1861) the federal general Nathaniel Lyon was defeated and killed.

**SPRUCE**, the name for coniferous trees of a section of the genus *abies*, which includes those with scattered leaves and pendent cones, the scales of which are persistent. (See Fir, Hemlock Spruce, and Pine.) The needle-shaped leaves are four-sided, and point in every direction; the cones hang from or near the ends of the branches, the scales remaining attached to the axis;

Black Spruce (Abies nigra).

the seed parting freely from the wing, and without balsamiferous vesicles; the anther cells opening lengthwise. The black, or as it is often called double spruce (*A. nigra*), extends from Maine to Wisconsin and further southward along the higher ranges, and in Canada reach-

es northward to 65°, it being partial to cold, swampy localities among the mountains. Its straight, tapering trunk, often 75 ft. high, bears a handsome conical head, if it has room to develop; but in a crowded forest the trunks are branchless, save a small tuft at the summit. The very short leaves, rarely more than half an inch long, are erect, stiff, and very dark green; the cones are 1 to 1½ in. long, dark purple when young, but when ripe (in November) pale brown; the seeds are shed the following spring, but the cones remain several years; the scales of the cones are uneven on the margin, and often notched or toothed. The wood is very strong, light, and durable, and is much used in ship building, not only for masts and spars, but in the hull, where it outlasts oak; it is much used for the sides of ladders, for the smaller timbers in house building, and for shingles. The recent shoots of this species are used in this country for making domestic beer. The tree is sometimes planted for ornament, and young specimens are very regular in form; but they get ragged as they grow older. The color of the foliage is rather sombre, and the so-called red spruce is merely a form of this with larger and redder cones and the wood tinged with red. The white or single spruce (*A. alba*) has a range similar to the preceding, and extends even further north than that; Richardson found it within 20 m. of the Arctic sea. The leaves are somewhat longer than those of the black spruce, and of a pale glaucous green; though the leaves are attached equally on all sides of the shoots, yet on the horizontal branches they curve upward in such a manner as to appear two-ranked; the cones, about 2 in. long, fall the first winter, and their scales have a firm, even edge. The wood of this is also valuable, some considering it not inferior to that of black spruce, and superior to it for spars; the long roots are remarkably tough, and the Indians prepare from them thongs or threads with which to sew their birch-bark canoes. The white spruce, when young, is of a regular conical shape, very compact, and its pale but lively green color makes a most effective contrast when it is planted near evergreens with darker foliage. In the forests of northern Michigan and Wisconsin, the lumbermen distinguish a blue spruce, which has more bluish leaves, while its cones are more like those of the black spruce. Several species are peculiar to the Rocky mountains and the Pacific coast; notable among these is Menzies's spruce (*A. Menziesii*), discovered by Douglas in northern California; it is abundant in Alaska, and extends eastward to the Rocky mountains, where it is known as balsam; it is a subalpine species, rarely found at a less elevation than 7,000 ft., and prefers low marshy soils or the margins of streams. It reaches 100 ft., but the average height is 60 or 70 ft.; it has a straight trunk and a regular pyramidal outline; the leaves are broader than in eastern species, silvery whitish beneath, very stiff, and almost spine-like; the cylindrical cones are about 3 in. long, their pale and thin scales irregular on the margin. The wood is very compact, but rather coarse-grained and resinous, and the trunks taper too rapidly to saw up to advantage. As an ornamental tree it is likely to become popular; it is quite hardy near Boston and in other northern localities; its growth in rich moist soils is very rapid. Engelmann's spruce (*A. Engelmanni*), 80 to 100 ft. high, was first discovered by Dr. Parry in the Rocky mountains, where it occurs from New Mexico to the head waters of the Columbia and Missouri, forming almost the entire

Norway Spruce (Abies excelsa).

forest growth of some of the mountain slopes, and is most luxuriant at the altitude of 9,000 to 10,000 ft.; much higher than this it becomes dwarfed; it resembles the eastern black spruce. Patton's spruce (*A. Pattoniana*) is a fine species found in the mountains of upper California and northward, and is described as reaching the height of 150 ft. and over.—Of the exotic spruces none is so well known as the Norway (*A. excelsa*), which is indeed the popular evergreen of this country; it is indigenous throughout northern Europe and Asia, in Russia and Siberia extending beyond the arctic circle, especially abundant in Norway, Sweden,

and the neighboring countries, and further south in the Alps, Pyrenees, and other ranges. It reaches a height of 120 to 150 ft. and a diameter of 3 to 5 ft., requiring a century to attain this development; when not crowded, its long stout branches spread out regularly on every side, forming a perfect pyramid; its dark green leaves are larger than in our black and white spruces, rigid and curved, and the conspicuous terminal cones are 6 or 7 in. long and pendent at maturity. The wood of the Norway spruce is of great value for many uses; sawn into boards, it forms a large part of the deals used for floors and other inside work, box making, cheap furniture, &c., while the round timber serves for masts, spars, scaffoldings, and framework; the wood is very durable, especially when the bark is left on; the bark is used for tanning. The resin of the tree rarely exudes spontaneously, but is obtained by removing a strip of bark, an inch or more wide and deep, and 3 ft. long, from the south side of the tree; the following year the groove is found filled with the turpentine, which is scraped off, and the groove enlarged by the removal of a thin strip of bark from each side of it; the product so obtained is one of the several turpentines called frankincense or thus (see FRANKINCENSE), and when melted in boiling water and strained it forms the true Burgundy pitch. (See PITCH.) The Norway spruce being so largely raised from seeds, there are numerous deviations or sports from the normal form, of which 20 or 30 are in cultivation; some vary in foliage, others are dwarfs, while a few are curious monsters; in var. *inverta* the branches are turned directly downward, and in var. *monstrosa* there is such a strong indisposition to branch, that it will throw up a leader 10 or 15 ft. high and perfectly naked. *A. obovata* from Siberia, and *A. orientalis* from the Black sea, are too near the Norway in appearance to be popular.—The Himalayan spruce (*A. Smithiana*), found high up the Himalaya mountains, and also in China and Japan, is a remarkably handsome species; it is not quite hardy at Philadelphia, but valuable further south.

**SPURGEON, Charles Haddon,** an English preacher, born at Kelvedon, Essex, June 19, 1834. His father and grandfather were preachers in the Independent denomination. At the age of 16 he became an usher at Newmarket, and subsequently at Cambridge. Not long after going to Cambridge he connected himself with a "lay preachers' association" there, and before he was 18 became pastor of a small Baptist congregation at Waterbeach. In 1853 he was called to the New Park street Baptist chapel in Southwark, London, to which his preaching attracted such crowds that the congregation removed first to Exeter hall, and then to Surrey music hall. In 1861 a new chapel capable of seating between 5,000 and 6,000 was completed for his congregation in Newington Butts. Mr. Spurgeon has received more than 13,000 persons into his church, and has erected 36 chapels in London, supplied with ministers trained in a college of his own founding. His sermons have been printed weekly, and 16 volumes have been published collectively, besides a volume entitled "Gems: Brilliant Passages from the Discourses of C. H. Spurgeon" (1859). He has also published "The Saint and his Saviour" (1857); "Gleanings among the Sheaves" (2d ed., 1868); "John Ploughman's Talk, or Plain Advice for Plain People," and "Evening by Evening: Readings for the Family and the Closet" (1869); "Feathers for Arrows, or Illustrations from my Note Book" (1870); "Types and Emblems" (1875); and "Lectures to my Students" (1875). Since 1865 he has edited a journal, "The Sword and Trowel."

**SPURZHEIM, Johann Gaspar,** a German phrenologist, born at Longwich, near Treves, Dec. 31, 1776, died in Boston, Mass., Nov. 10, 1832. In 1795 the French invasion interrupted his studies at the university of Treves, but he continued them at Vienna. Here he became the most eminent pupil of Gall, whom he afterward aided in the development and popularization of his doctrines. In 1805 he joined him in his travels and lectures in various parts of Europe, settled with him in Paris in 1807, and was intimately associated with him till 1813. He then delivered lectures in London, which were attacked by Dr. John Gordon in the "Edinburgh Review." In reply Spurzheim demonstrated at Edinburgh, before hundreds of Gordon's students, the fibrous character of the brain, which the latter had denied. After residing several years in Paris, he resumed his lectures in Great Britain in 1825, and in 1832 went to Boston, where he delivered several lectures. Besides his share in the most important publications of Gall, and several works of his own in French, he published "The Physiognomical System of Dr. Gall and Spurzheim" (London, 1815); "Outlines of the Physiognomical System" (1815); "View of the Elementary Principles of Education" (Edinburgh, 1821; enlarged ed., London, 1828); "Phrenology in connection with the Study of Physiognomy" (London, 1826); "The Anatomy of the Brain, with a General View of the Nervous System" (1826); "Outlines of Phrenology" (1827); and "Sketch of the Natural Laws of Man" (1828).—See "Memoir of the Life and Philosophy of Spurzheim," by Andrew Carmichael (Dublin, 1833).

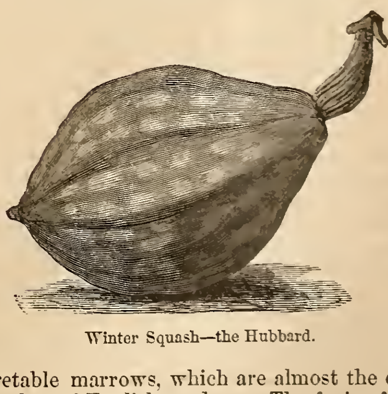
**SPY,** in war, one employed to penetrate the enemy's lines and ascertain his condition and plans. Spies have always been employed in warlike operations, and writers on the laws of war lay down the principles which are to regulate their conduct. Though thus recognized, a stigma is attached to their employment as one to which falsehood and treachery are indispensable, and a captured spy is not admitted to the privileges of a prisoner of war, but is put to an ignominious death. The difficulty of

determining who is to be treated as a spy is sometimes very great. Presumptively one who is within the enemy's lines in disguise or wearing the enemy's uniform is a spy; but the dress is only a circumstance indicative of an intent to deceive, and other circumstances might be equally conclusive. One belligerent may employ the subjects of the other as spies, but a peculiar infamy attaches to one who to a discreditable occupation adds the atrocious crime of treason. A spy is not restricted to obtaining information; he may inflict injury upon the enemy, so that he do not resort to assassination, poisoning, or other means which, in the words of Vattel, "affect the common safety of human society." Inciting a spy to such atrocity would subject a commander and his forces to retaliation. An employment at once so dangerous and so discreditable cannot be forced upon any one; the commander must usually procure his spies by heavy rewards.

**SQUASH,** the name of several species and varieties of *cucurbita*, of the order *cucurbitaceæ* or gourd family, called by the North American Indians *askutasquash.* The characters of the family are given under GOURD, and those of the genus under PUMPKIN. In no genus of cultivated plants is there more difficulty in tracing varieties to the species from which they are derived, or in ascertaining the countries in which they originated, than in *cucurbita*, and in this country the terms pumpkin and squash are used very indefinitely, large forms of what are evidently squashes being called pumpkins. Naudin, who experimented with over 1,200 living plants, could make but four distinct species, to all of which he ascribes an eastern origin; only three of these are cultivated in this country. On the other hand, Roger Williams and other writers on early New England history found some *cucurbita* in general cultivation among the Indians, and we derive from them the common name by which the plants are known in this country. One species, *C. ovifera*, is cultivated for ornament as orange gourd, mock orange, egg gourd, or fancy gourd, and rarely in vegetable gardens as egg squash, to be eaten while young; this, which in cultivation presents a great variety of shapes and markings, grows wild in Texas, and Gray thinks it is probably the original of all the crook-necked squashes, vegetable marrows, and even the common pumpkins. It will serve the present purpose to enumerate the leading varieties in cultivation, without attempting the difficult task of tracing them to their original species.—The ordinary early summer squashes are also called bush squashes; the vine has lost its tendency to run a long distance, the tendrils have disappeared, the petioles or leaf stalks are much longer than in any others, and the fruits all have angled stems; the most common of these are the scalloped bush sorts, in which the fruit is somewhat hemispherical with an expanded edge, which is deeply and regularly scalloped; of these there are varieties with the rind pure white, yellow, green, green striped with white, and yellow marked with green; from their peculiar shape they are often called "patty-pans," and in Virginia they are known as cymlings. Another very distinct bush variety is


1. Crook-neck Squash. 2. Scalloped Squash.

the summer crook-neck, in which the fruit is about 8 in. long, largest near the base and tapering toward the stem, where it is usually curved; the skin is bright yellow, and nearly covered with warty protuberances; this is the best of the early varieties, all of which should be used while the rind is tender.—The late varieties all have strong running vines, extending 12 ft. or more, and taking root at the joints; they differ in their times of ripening and in their keeping qualities, but all of them, even if taken when quite young, are better for the table than any of the bush sorts. The Canada crook-neck is small, with a curved neck, and cream yellow or darker when ripe; the skin never gets very hard. The winter crook-neck is many times larger, and though not so fine in quality is more generally cultivated, and both with care will keep the year round; both have angled stems, which indicate a relationship with the bush sorts, as have the various



Winter Squash—the Hubbard.

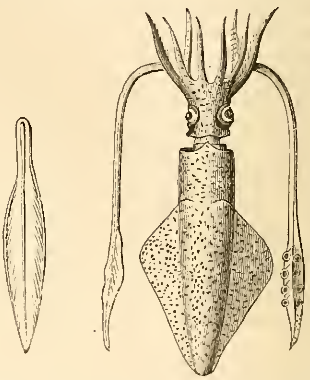
vegetable marrows, which are almost the only squashes of English gardens. The fruit of the marrows is elliptical, 9 in. or more long, and of a pale straw color; there are several sub-varieties. The autumnal or Boston marrow has an egg-shaped fruit, pointed at each end,

the stem large and fleshy, skin never becoming hard; color reddish at maturity; quality excellent. This has for a long time been regarded as the best of all winter varieties, but it is excelled by the Hubbard, which is somewhat similar in shape and in character of stem; the color of the often ribbed rind is clay-blue or olive-green, and it becomes so extremely hard that it requires to be cut with a hatchet; the flesh is thick, dry, and sweet; it keeps till spring. The Butman is similar in form, skin white and green, and regarded as the finest of all. The Yokohama, from Japan, is a singularly flattened variety, with a much warted green skin, which turns to orange; this has a very long and angled stem. The turban variety is of good quality, and is remarkable for a projection of a portion of the fruit beyond the line which shows where the calyx tube was attached to the ovary.

**SQUASH BUG,** a well known hemipterous insect, the *coreus tristis* (De Geer). It is about three quarters of an inch long, with a triangular head; the general color is ochre yellow, rendered dusky above by numerous black dots; the sharp edges of the abdomen project beyond the closed wing covers; on the back of the head, behind the eyes, are two glassy raised eyelets. They appear by the last of June or beginning of July, when the squash vines have put out a few leaves, pair, and soon begin to lay their eggs; they conceal themselves by day, and in the evening fasten their eggs in little patches on the under side of the leaves by a gummy substance; the eggs are soon hatched, and the young, pale ashy and with large antennæ, appear in successive broods during summer, pass through their last change, attain their full size in September and October, and pass the winter and spring in a torpid state in crevices. The loss of sap from the punctures of these insects causes the leaves to become brown, dry, and wrinkled, when they are deserted for fresh ones. When irritated, and particularly when crushed, they give out a strong, nauseous odor. It is best to destroy them before they have laid their eggs.

Squash Bug (Coreus tristis).

**SQUID,** a cephalopodous mollusk, of the dibranchiate order, tribe *decapoda*, family *teuthidæ*, of which the typical genus is *loligo* (Lam.). The body is elongated, tapering behind, with a pair of terminal fins; branchiæ two; arms eight, with two rows of pedunculated suckers, and two very long tentacles; the internal shell, or *gladius*, is reduced to a horny quill-shaped plate, with two lateral expansions; the ink bag is well developed, and its secretion jet black. They are good swimmers, all marine, and never leave the water; they can creep head down on the cephalic disk; the ova are enclosed in long, gelatinous, cylindrical sheaths, called sea grapes, and may be nearly 40,000 in number; the sight is good, and the movements are rapid. They are sometimes called calamaries, from the internal pen-like bone and ink bag, and the general cylindrical form like an ancient escritoire. The small species are gregarious, but the large hooked squids are solitary and oceanic. The common squid of the New England coast, the *L.* [*ommastrephes*] *illecebrosa* (Lesueur), is from 6 to 12 in. long; the colors vary rapidly, with the will of the animal, from yellowish white to bluish, violet, brown, red, and orange, in spots or general tint. They swim rapidly backward by dilating and contracting the sac-like body, and forward by the terminal fin; they devour numbers of small fish and crustaceans, and are eaten by larger fishes, and used as bait by cod fishers. Squids are found from Norway to New Zealand; the *L. vulgaris* (Lam.), common about the shores of Great Britain, and used in Cornwall as a bait for cod, attains a length of 1 to 1½ ft. The occurrence of large squids on the North American coast has within a few years directed attention to old stories of the gigantic mythical *kraken* of Pontoppidan. Prof. Steenstrup has collected many instances of gigantic squids on the coasts of northern Europe from 1549 to the present time; they have also been found in tropical and southern waters, and were known to Aristotle and Pliny. It is proved that the sperm whale feeds chiefly upon these large squids, and many interesting fragments have been obtained from the stomach of this cetacean. In 1872 one was found floating dead on the Grand Banks, 15 ft. long, 4⅝ ft. in circumference, and the longest arms 9 ft.; this was probably the *architeuthis monachus* (Steenstrup), or the sea monk. (See "American Naturalist," February, 1873.) In October, 1873, one was seen, and a piece of an arm cut off, near the coast of Newfoundland; the body was about 10 ft. long, with a diameter of 2½ ft., head 2 ft. long, and caudal fin 22 in. wide. The creature being wounded attacked the boat, when the fisherman cut off one of the arms with his axe, about 20 ft. long and at least 10



Common Squid of Great Britain (Loligo vulgaris).

ft. from the body, the whole arm being more than 30 ft., and the total length of the animal about 44 ft. The most characteristic features are: the irregularity of the rows of lingual teeth, the very simple internal shell or pen, embryonic form of caudal fin, and clusters of small suckers and tubercles on long arms; the first three indicate a low rank in the family, below *loligo* and *ommastrephes;* it may be a modification of the Jurassic *teudopsis* preserved by its oceanic habitat to the present time, like other huge marine types having a mesozoic aspect. (See SEA SERPENT.) Probably some of these great squids of the genus *architeuthis* attain a total length of 50 ft., including the long tentacles; the largest known is probably the *A. princeps* (Verrill), from Newfoundland.

**SQUIER, Ephraim George,** an American archæologist, born in Bethlehem, N. Y., June 17, 1821. He early became an engineer and a journalist. In 1845 he made a survey, in conjunction with E. H. Davis, M. D., of the ancient monuments of the Mississippi valley, the results of which were published in 1848 in "Ancient Monuments of the Mississippi Valley," being vol. i. of the "Smithsonian Contributions to Knowledge;" and in 1848 he explored the aboriginal monuments of the state of New York. In 1849 he was appointed chargé d'affaires to Guatemala; in 1853 assisted in the survey of an interoceanic railway route through Honduras, for the construction of which he formed a company; in 1863-'4 was United States commissioner to Peru to adjust claims, devoting many months to exploring the ancient monuments of that country; and in 1868 was for a time United States consul general to Honduras. At intervals he has edited newspapers at Albany, N. Y., Chillicothe, O., Hartford, Conn., and New York, and has several times visited Europe. Besides the above mentioned work and numerous archæological papers contributed to American and European scientific periodicals, he has published "Aboriginal Monuments of the State of New York" (4to, Washington, 1851, being vol. ii. of the "Smithsonian Contributions"); "Antiquities of the State of New York" (8vo, Buffalo, 1851), with a supplement on the antiquities of the west; "Nicaragua, its People, Scenery, Ancient Monuments, and proposed Interoceanic Canal" (2 vols. 8vo, New York and London, 1852); "The Serpent Symbol, or Worship of the Reciprocal Principles of Nature in America" (8vo, New York, 1852); "Notes on Central America," &c. (1854); "Waikna, or Adventures on the Mosquito Shore," under the *nom de plume* of Samuel A. Bard (12mo, 1855); *Question Anglo-Américaine*, &c. (8vo, Paris, 1856); "The States of Central America," &c. (8vo, New York, 1857); "Report of the Survey of the Honduras Interoceanic Railway" (4to, London, 1859); "Translation, with Notes, of the Letter of Don Diego de Palacio (1571) to the Crown of Spain on the Provinces of Guatemala, San Salvador, &c." (New York, 1860); "Monograph of Authors who have written on the Aboriginal Languages of Central America" (1861); "Tropical Fibres and their Economic Extraction" (1861); "Is Cotton King? Sources of Cotton Supply" (1861); "Honduras, Descriptive, Historical, and Statistical" (London and New York, 1870); and "Peru: Incidents of Travel and Exploration in the Land of the Incas" (New York, 1876). Most of his books have been translated into German, French, and Spanish.

**SQUILL** (Lat. *squilla* or *scilla*), a drug consisting of the sliced and dried bulbs of the *scilla maritima* of Linnæus, but the plant has been separated from this genus and is now the *urginea maritima* of Baker; it belongs to the lily family, and is a native of the Mediterranean region. It has a large, pear-shaped, onion-like bulb, sometimes weighing 4 lbs.; the leaves are long, flat, and spreading; the scape about 2 ft. high, terminated by a long dense raceme of white flowers. It is not rare in cultivation as a window plant, but has no great beauty. The only preparation given the bulbs is to slice them transversely and dry the pieces in the sun; there are two varieties, the white and the rose-tinted bulbs, the later making a dark-colored and less esteemed product. As found in the shops, squill is in the form of horn-like, curved strips, which can only be pulverized by thorough drying, and unless the air be excluded from the powder it absorbs moisture and soon becomes a solid mass. The taste is mucilaginous, bitter and acrid; its properties

Squill (Urginea [Scilla] maritima).

are ascribed to a principle called scillitine, which has not yet been isolated. Squill is one of the oldest of medicines, and its use is mentioned by the earliest writers; some antiquaries think that the onion which the Egyptians regarded as sacred was really the squill bulb.

Its medicinal effects are diuretic and expectorant, and in large doses emetic and purgative. It is largely employed as an expectorant in domestic practice, for croup and similar affections of children. Vinegar or dilute acetic acid is found the best solvent of the active principles of squill; the drug is first exhausted by the acid, and the vinegar of squill thus obtained is made into a sirup with sugar.

**SQUILL** (*squilla*, Fabr.), a genus of crustaceans of the division *stomapoda*, so called from having the feet placed around the mouth. The body is elongated and generally slender, the head distinct from the thorax, the carapace leaving uncovered four of the thoracic rings, and the abdomen terminating in a wide caudal fin of several plates adapted for swimming. The antennæ of the first segment of the body are long, ending in three many-jointed filaments, cannot be bent under the head, and are inserted below the eyes near the median line; the antennæ of the second segment are shorter, more external, having at the base a large ciliated plate, and terminate in a single many-jointed filament; the eyes are at the end of movable appendages. The mouth is toward the posterior third of the carapace, and has an upper and under lip, a pair of mandibles, and two pairs of jaw feet arranged around it; the third pair of feet are prehensile, strong, bent back on themselves, serrated and spined, and used very much like the first pair of feet in the soothsayer (*mantis*); the next three pairs are directed forward, applied against the buccal apparatus, and inserted close together, with a wide, rounded, ciliated plate at the end; the last three thoracic limbs are slender, with styliform process and ciliated, the segments to which they are attached resembling those of the abdomen. Most of the rings of the body are complete, very nearly equal, and movable on each other; the carapace is nearly quadrilateral, longitudinally divided by two more or less distinct grooves; the first five abdominal rings have large false feet, to the posterior part of the base of which are attached the respiratory organs in the shape of floating, ramified, and fringed gills, which are kept constantly in motion. The heart extends almost the length of the abdomen and thorax, a little dilated anteriorly, sending off lateral branches to each ring; the venous sinuses in which the blood is collected before going to the gills are very large; the stomach advances far into the head. There are many species, all marine, most abundant in the tropics, but occasionally seen as far north as the English channel; they are usually met with far from shore and in deep water; they swim rapidly; they are voracious and carnivorous. The best known species is the *S. mantis* (Fabr.), 6 or 7 in. long, pale yellowish gray, found in the Mediterranean.


Squill (Squilla mantis).

**SQUINTING** (Lat. *strabismus*), a deformity consisting in a want of parallelism between the visual axes of the eyes. Except in cases where it is caused by paralysis, spasmodic or hydropical affections, or irritation of the brain, it is not a disease, and is not accompanied with pain. Ophthalmic surgeons notice three degrees of squinting: 1, where there is but a slight convergence or divergence from the normal axis, such as is ordinarily called a "cast of the eye;" 2, where the inclination is strongly marked, but less than half the cornea is thrown under the eyelid or within the orbit, which is the most frequent variety; 3, where the cornea is nearly or quite thrown under the eyelid or within the orbit, common among those who are born blind, but rare in the case of those who can see. The surgeons also distinguish it according to the departure from the normal axis; as convergent, where the pupil is drawn toward the nose; divergent, where it is drawn toward the outer corner of the eye; ascendent, where it is drawn upward; and descendent, where it is drawn downward. Of these, the convergent form is by far the most frequent, and next in order the divergent and ascendent. The descendent is the rarest of all. Squinting may also be double or single as one or both eyes are affected; it may be congenital, *i. e.*, existing from birth, or accidental, occurring from accident or improper treatment of the eye; the former is rare. It may be also continuous, or rarely intermittent. When not due to one of the causes mentioned above, it depends in a large majority of cases on parallel rays of light not focusing on the retina. To correct this the eye turns in, as in so doing the power of accommodation is increased, because the same nerve which supplies the internal rectus also supplies the muscle of accommodation. (See EYE.)—The treatment prior to 1839 consisted in attempting by various methods to strengthen the weaker muscles, bandaging the normal eye, and compelling the constant use of the other; or by the use of goggles, spectacles, &c., in which all except the centre was opaque. In 1838 Stromeyer described the operation of dividing one of the *recti* muscles, but without having tried it on the living subject. In 1839 Dieffenbach, an eminent surgeon of Berlin, performed it successfully, and

was followed by many English and French surgeons. The operation has now become very common, though the best surgeons admit that there are three classes of cases in which it should not be performed, viz.: those in which the position of the eye is fixed, those which result from the paralysis of the antagonist muscle, and those occurring in infants before dentition. The operation is not difficult nor particularly dangerous, and is generally successful. There are two methods of performing it, the ordinary or that of Dieffenbach, where the conjunctiva is divided and the muscle to be severed is laid bare, and the subconjunctival, where the conjunctiva is divided to a much less extent. The latter is generally preferred.

**SQUIRREL,** the popular name of the rodents of the family *sciuridæ*, which is very numerous in species, and widely spread over the world, except in Australia. They are characterized by a broad head, the frontal bone being dilated into a post-orbital process; the muzzle wide, from the development of the frontal and nasal bones; eyes large and prominent, ears moderate, and whiskers long; the hind feet five-toed, the fore feet four-toed, with a wart-like thumb, all the fingers and toes with compressed and curved claws; the fur is generally soft, especially in the northern species, and the tail is long, hairy, expanded laterally in the arboreal genera, and shorter and bushy in the terrestrial, and in both carried gracefully over the back; the upper lip is cleft, the cæcum large, clavicles perfect, enabling them to use the fore limbs to convey food to the mouth, and the tibia and fibula distinct; some have a membrane extended between the fore and hind limbs. (See Flying Squirrel.) The incisors are $\frac{2}{2}$, smooth in front, brown or orange, the lower compressed and sharp; molars $\frac{5-5}{4-4}$, rooted, tuberculate, with projecting transverse striæ enamelled continuously, the anterior upper one the smallest and sometimes deciduous. The food is chiefly vegetable, though some American species are known to suck eggs and destroy young birds. The family is very abundant in North America, nearly one third of all the species being found here; the prairie dogs and prairie squirrels are peculiar to this continent, as well as most of the flying squirrels. (See Prairie Dog, and Prairie Squirrel.)—The genus *sciurus* (Linn.) is the type of those of the family which live in trees; the species of the United States are hard to determine from the tendency to variation in color (red, gray, and black being the predominating tints), and the diminution in size in the southern states. Baird gives it as a general rule that, when a squirrel has the fur of the throat or belly annulated, it is a variety of some species which normally has the under parts uniformly white or reddish to the roots, or the latter plumbeous. The bones of the red-bellied squirrels are generally red, and of the white-bellied white. The largest of the North American species is the fox squirrel of the southern states (*S. vulpinus*, Gmel.), about 2¼ ft. long, of which the tail is 15 in.; the head is rather slender and pointed, and the tail rather cylindrical; the upper molars are permanently four. The color varies from a gray above and white below, through various shades of rusty, to uniform shining black; the fur is coarse and harsh, and the ears short; the ears and nose are white in all its varieties. It is found from North Carolina through the S. Atlantic and gulf states to Brazos river in Texas. The gray variety is the *S. capistratus* (Bosc), and the black the *S. niger* (Linn.) and the black squirrel of Catesby. It prefers elevated and open pine ridges where there are occasional oak, hickory, and other nut trees; the nest for the winter and breeding seasons is made in a hollow tree, and in summer in the forks between the branches. The young are born in March and April, and fed by the parents for four or five weeks. The food consists of acorns, nuts, fruit of the pine cones, green corn in summer, buds and roots in spring, and whatever it can get in winter, as it does not appear to lay up any winter stores, or to resort to any hoards previously buried. When alarmed, it makes for a hollow tree; it is a swift runner, defends itself boldly, and is very tenacious of life; it is generally seen toward the middle of the day; it is easily domesticated, but is less active in the cage than the smaller species; its flesh is frequently eaten. The cat squirrel (*S. cinereus*, Linn.), the fox squirrel of the middle states, is 25 or 26 in. long, of which the tail is about 14 in.; the head is very broad, the muzzle short and cat-like, the body thick and heavy, and the tail large and flattened; the color varies from light gray tinged with rusty above and white below, to grizzly above and black below; it is never pure black; the ears are low and broad, and never white; the hair is less coarse and stiff than in the preceding species. It is found chiefly in the middle states, rarely in southern New England; it is rather a slow climber, and of inactive habits; it becomes very fat in autumn, when its flesh is excellent. The species called fox squirrel in the western and southwestern states (*S. Lodovicianus*, Harlan) has a very full and broad tail; it is rusty gray above and ferruginous below. The common gray squirrel (*S. Carolinensis*, Gmel., and *S. migratorius*, Aud. and Bach.) is about 22 in. long, of which the tail is 12 in.; the upper molars are permanently five. The general color is gray above and white below, with a yellowish brown wash on the back and sides; the region behind the ears has usually a white woolly tuft; there is a black variety, the *S. niger* of Godman. The ears are very high, narrow, and acute, the tail flattened, feet large, claws strong, thumb a rudimentary callosity; the palms naked, and soles mostly so in summer; whiskers longer than the head. It is found extensively over the United States, being much the smallest at the south. The young are four

to six, born in May or June. They are easily domesticated and gentle in confinement, and are often kept as pets in wheel cages; they do not lay up any great amount of winter stores, being partially torpid at this season and requiring but little food; they are very fond of nuts, and of green corn and young wheat, on which last account wars of extermination are often waged against them, whole villages turning out to hunt them. At irregular periods they sometimes collect in large troops in the northwest, migrating eastward, crossing rivers and mountains, and committing great destruction in the fields in their course. Many of this species have been domesticated in the public parks of northern cities, where they drive

Common Gray Squirrel (Sciurus Carolinensis).

away the birds by destroying their eggs and young. The California gray squirrel (*S. fossor*, Peale) is as large as the fox squirrel, but more slender; it is grizzled bluish gray and black above and white below; tail black, white on the exterior, and finely grizzled below; back of ears chestnut. It represents on the west coast the gray squirrel of the east. It runs very swiftly on the ground, not readily taking to trees when pursued; like the other squirrels, it has a kind of bark; the food consists principally of nuts, which it sticks in holes of pine trees bored by woodpeckers, resembling pegs placed in the wood. The red or Hudson bay squirrel (*S. Hudsonius*, Pall.) has been described under CHICKAREE.—The common European squirrel (*S. vulgaris*, Linn.) is about 14 in. long, of which the tail is about one half; the color is reddish, chestnut brown on the back, white below, becoming gray in winter in the north, and yielding then the much prized fur called minever; the ears are tufted, and the hair on the tail is directed to the two sides. It is found throughout Europe and N. Asia; it feeds in summer on buds and shoots, especially the young cones of the pine, and in winter on a supply of nuts which it gathers in autumn and hides in some hollow tree. It is an excellent climber, and makes a nest of moss, leaves, and fibres very neatly interwoven, in a hole or fork of a tree, and well concealed; a

Common European Squirrel (Sciurus vulgaris).

pair live together, frequenting the same tree for many years; the young are born in June, and remain with their parents till the following spring; they are torpid in the very coldest days. The largest of the squirrels is the Malabar squirrel (*S. maximus*, Schreb.), 33 in. long, as large as a cat; it is black above, the sides and top of head chestnut, and lower parts pale yellow; it lives in palm trees, feeding on the cocoanut.—The ground squirrels (*tamias*, Illig.) have been described under CHIPMUNK.

**SQUIRREL, Flying.** See FLYING SQUIRREL.

**SQUIRREL CORN.** See DICENTRA.

**STAAL, Marguerite Jeanne Cordier de Launay de,** baroness, a French writer, born in Paris about 1690, died at Gennevilliers, near Paris, June 16, 1750. She was a daughter of a poor painter named Cordier, was educated in an abbey at Évreux till 1710, was afterward an inmate of the priory of St. Louis at Rouen, and finally became a maid to the duchess du Maine. With her she was implicated in the conspiracy of Prince Cellamare, the Spanish ambassador at Paris, against the duke of Orleans, and for giving the regency to the king of Spain. After being confined in the Bastile from December, 1718, to 1720, she resumed her former post in the duchess's petty court at Sceaux, and retained it even after her marriage in 1735 with the aged baron de Staal. Her memoirs (3 vols., 1755) passed through many editions, and with her correspondence are included in her complete works (2 vols., 1821). An extract from the memoirs, entitled *Deux années à la Bastile*, appeared in 1853.—See Sainte-Beuve's *Derniers portraits littéraires* (1852).

**STADE,** a town of Prussia, capital of a district in the province of Hanover, on the Schwinge, 4 m. above its confluence with the Elbe, and

20 m. W. of Hamburg; pop. in 1871, 8,693. It is of great antiquity, and was ruled by local counts until the close of the 12th century, when the last count became archbishop of Bremen. The Elbe dues raised at Stade caused the Hansa in 1267 to enter upon hostile proceedings. The dues were restored in 1688 under Swedish domination, and increased by George I., as elector of Hanover, after the annexation of the town in 1719, together with the duchy of Bremen, to his dominions; and they were not finally abolished till 1861, when Hanover received a compensation for them of 3,100,000 thalers, Great Britain and Hamburg respectively contributing one third, and other maritime nations the remainder. The fortress was captured by the Prussians, June 18, 1866.

**STADIUM** (Gr. *στάδιον*), originally a Grecian course for foot races at the places where games were celebrated, and sometimes in the gymnasia of cities where there were no games. The most celebrated stadia were those at Olympia, Delphi, Thebes, Epidaurus, and the Panathenaic at Athens. The stadium was an oblong area terminated at one end by a straight line, and at the other by a semicircle, with ranges of seats rising above one another in steps around the circumference. The length of the stadium at Olympia was 600 Grecian ft., equal to 606 ft. 9 in. English; and from continual reference to it as a comparison, this length became used throughout Greece as the standard of measurement for itinerary distances, and was subsequently adopted by the Romans, chiefly for nautical and astronomical measurement. The stadium at Ephesus was 685 ft. long and 200 ft. wide, and it was used not only as the arena for foot races, wrestling, and pugilistic combats, but also for combats with wild beasts.

**STADTHOLDER** (Dutch, *stadhouder*, city holder or governor), the title given by certain of the United Provinces of the Netherlands to William of Orange, who thereupon became the chief magistrate or president of those provinces and commander-in-chief of their forces. In 1587 Maurice, his son, was appointed stadtholder of the United Provinces, and the dignity continued in the house of Orange, with occasional intermissions during which the states general governed without a stadtholder, till 1747, when William IV., of a collateral branch of the Orange family, was declared hereditary stadtholder. After the restoration of the Orange family in 1814, the title was exchanged for that of king.

**STAËL-HOLSTEIN, Anne Louise Germaine Necker de**, baroness, a French authoress, born in Paris, April 22, 1766, died there, July 14, 1817. She was the only child of the finance minister Necker (originally of Geneva), whom she idolized, and whose fondness mitigated the excessive austerity which her mother brought to bear upon her education. She early displayed her literary genius and brilliant conversational power, which was much stimulated by her precocious discussions with the many learned friends of the family. She became especially interested in the celebrated Matthieu de Montmorency; but her mother arranged for her a conventional marriage with the Swedish ambassador, Baron de Staël-Holstein, which at the age of 20 made her the centre and, owing to her commanding presence and intellect, the oracle of a distinguished society. She hailed with delight the revolution of 1789, but deplored its excesses; and after devising a plan for the safety of the royal family, which was not acted upon, she saved Montmorency and other friends from the guillotine, though barely escaping herself. After joining her parents at Coppet, she went to London, where she at once (1793) published an appeal in behalf of Marie Antoinette. Here she met Talleyrand, whom she afterward helped to return to France and to enter the ministry of foreign affairs. Under the directory she was conspicuous in Paris as a leader of the constitutional party in conjunction with Benjamin Constant, and her influence was so great that Joseph Bonaparte offered to obtain for her 2,000,000 francs due to her father from the treasury, in the hope of overcoming her prejudices against his brother Napoleon; but she resisted, though she subsequently accepted the money from Louis XVIII. She was not permitted to remain in Paris, and took refuge with Mme. Récamier. When she returned to the more immediate vicinity of the capital, a work published by her father (1802) served as a pretext for her banishment 40 leagues from Paris, and she went to Germany. At Weimar she became acquainted with Goethe, Schiller, the brothers Schlegel, and others, and at Berlin with the royal family of Prussia. In the spring of 1804 she hastened home to attend her father in his last illness, but when she reached Coppet he was dead. Broken-hearted and out of health, she sought relief in her memorable journey to Italy. In the summer of 1805 she returned to Switzerland in company with August Wilhelm von Schlegel, her mentor in regard to Germany, and the instructor of her children. She now alternately resided at Geneva and Coppet, her château in the latter place (now belonging to Baron Rothschild) being a resort of her friends, and especially for some time of Mme. Récamier. For a time she was tolerated in France, but having in 1807 removed to the vicinity of Paris to confer with her publishers about *Corinne* and secretly visited the capital, she was ordered back to Coppet. In 1810 she made an equally unsuccessful attempt to bring out her book on Germany, taking up her residence in the country house of her friend Montmorency. She was ruthlessly expelled, and although thousands of copies had been issued with the sanction of the censorship, the work was confiscated, no motive being assigned excepting that "it was not French," probably referring to its excessive appreciation of German thought.

On the birth of the emperor's son (1811) it was intimated to her that she might soften him by commemorating the occasion; she replied that she wished the child to receive the care of a competent nurse; and this and other remarks of hers becoming known to Napoleon, he actually converted her residence at Coppet into a prison. Schlegel was not permitted to remain; Mme. Récamier, Montmorency, and the duke de Broglie were not tolerated in Paris for having visited her; and she was forbidden to go beyond two miles from her house. Her position became intolerable, and as the seaports were closed to her, she could only escape, in the spring of 1812, by pretending to take a little walk from which she never returned. She went across the Swiss and Tyrolese mountains, and finally reached Vienna. As Napoleon's emissaries beset her even here, she made a tedious journey through Galicia and the duchy of Warsaw to Moscow, and thence to St. Petersburg, where the imperial family received her with open arms; but she vindicated her patriotism at a banquet, when on a toast being proposed for the victory of Russia over France, she exclaimed: "Not over France, only over her oppressor." During her visit at Stockholm her youngest son Albert fell in a duel (1813), shortly before her departure for London, where she attended to the publication of her work on Germany. She returned to Paris on the fall of Napoleon in 1814, but left it on his return from Elba. In 1816 she made an unsuccessful attempt to restore her health by another journey to Italy. Schlegel was with her to the last, and Chateaubriand first met Mme. Récamier at the deathbed of Mme. de Staël. Her remains were removed to the family vault at Coppet.—Of her three children by her first husband (from whom she was separated for several years, though she rejoined him in his last illness, and who died on May 9, 1802), Auguste (author of *Lettres sur l'Angleterre*, 1826, and other writings) survived her till Nov. 11, 1827, and Albertine, wife of the duke Achille de Broglie, till September, 1838. She had one child by her second husband, Albert Jean de Rocca, a French officer and military writer, who died in January, 1818, in his 31st year. It seems that on meeting him at Geneva, whither he had retired after being severely wounded in the peninsular war, she became interested in him, and in 1811 she married him secretly, in order, as she said in her will, which first disclosed the fact, to retain the name identified with her fame.—Mme. de Staël's versatility was remarkable. She excelled in every branch of prose composition, as a linguist, in a measure as a vocalist and dramatist, and in private theatricals; and she was especially celebrated for bold and suggestive generalizations, a masculine grasp of thought, an irrepressible flow of ideas and language, and for a love of humanity and constitutional liberty after the model of England. Her best known works are: *Delphine*, a novel in which she idealizes herself (4 vols., Geneva, 1802); *Corinne, ou l'Italie* (3 vols., Paris, 1807); and *De l'Allemagne* (3 vols., London, 1813), which first fully revealed to the French the achievements of modern German literature. These works have passed through many editions and translations, as well as most of her other writings, which include *Lettres sur les écrits et le caractère de J. J. Rousseau* (1788); *Réflexions sur la paix* (1794); *De l'influence des passions sur le bonheur des individus et des nations* (1796); *De la littérature considérée dans ses rapports avec les institutions sociales* (1800); *Considérations sur les principaux évènements de la révolution française* (3 vols., 1818; new ed., 2 vols., 1861); and *Dix années d'exil* (1821; new ed., 1861). Her complete works were edited by her son Auguste (17 vols., 1820–'21), with a notice by Mme. Necker de Saussure; and her daughter threw additional light upon her mother's life in her notes accompanying an edition of her brother's *Œuvres diverses* (5 vols., 1828–'9). Mme. de Staël's correspondence with the grand duchess Louisa of Saxe-Weimar from 1800 to 1817 appeared in London in 1862, and other letters of hers were published by Saint-René Taillandier (1863).—See Sainte-Beuve's *Portraits de femmes* (1844), Baudrillart's *Éloge de Mme. de Staël* (1850), and "Life and Times of Mme. de Staël," by Norris (London, 1853).

**STAEMPFLI, or Stämpfli, Jakob,** a Swiss statesman, born at Schüpfen, canton of Bern, in 1820. He is the son of a farmer, and acted as a servant in France in order to acquire the language. Subsequently he studied law in Bern, and became an advocate and an ultra-radical journalist. In 1846 he and Ochsenbein were the chief promoters of the revision of the constitution, and in the same year he presided over the financial department in the council of state. In 1847, as representative of the canton of Bern in the diet, he was prominent in pushing on the war with the seven Catholic cantons which had formed the Sonderbund, and in insisting upon the expulsion of the Jesuits. In 1848 he failed of election to the national council, on account of his objections to the new constitution. In 1849, 1851, 1859, and 1862 he was president of the republic, and in the intervals he was vice president and minister of war; and he resumed the latter office in 1863. In 1865 he retired, and in 1872 he was one of the arbitrators at Geneva under the treaty of Washington.

**STAFFA,** a small uninhabited island of Scotland, one of the inner Hebrides, Argyleshire, about 8 m. W. of Mull. It is irregularly elliptical, about 1½ m. in circumference. Its surface is an uneven plateau, elevated from 50 to 144 ft. above the sea. It is covered with a rich soil and luxuriant grass, and is pastured by black cattle. The upper rock is composed of a shapeless basaltic mass, with occasional small columns, resting upon a columnar basalt, hard, grayish black, compact, and of perfectly

regular forms, which has for its foundation a conglomerate trap or tufa. This columnar basalt, strongly resembling architectural designs, is indented with numerous caves, of which the most remarkable is that known as Fingal's cave. (See FINGAL'S CAVE.) The other principal caves are the Boat cave, the Cormorant cave, so called from the number of these birds which visit it, and the Clam Shell cave, which derives its name from the peculiar form in which the basaltic columns are inclined, giving it the appearance of a shell of the genus *pecten;* it is 30 ft. high, 16 to 18 ft. broad, and 130 ft. long. Buachaille or the Herdsman is a conical pile of columns rising 30 ft. above the water, and resting on a bed of horizontal columns over which the high tide rises. Between the Herdsman and Fingal's cave stretches the Great Causeway, formed by the ends of hexagonal upright columns.

**STAFFORD. I.** An E. county of Virginia, bordering on the Potomac, bounded S. W. by the Rappahannock, and drained by Aquia and other creeks; area, 335 sq. m.; pop. in 1870, 6,420, of whom 1,485 were colored. The surface is hilly, and the soil along the Potomac is moderately fertile. Gold has been discovered, and excellent granite and freestone are found. The Richmond, Fredericksburg, and Potomac railroad intersects the county. The chief productions in 1870 were 30,763 bushels of wheat, 99,057 of Indian corn, 39,586 of oats, 1,070 lbs. of tobacco, and 3,174 of wool. There were 942 horses, 1,408 milch cows, 1,893 other cattle, 1,428 sheep, and 3,393 swine. Capital, Stafford Court House. **II.** A W. central county of Kansas, intersected in the N. W. by the Arkansas river; area, 900 sq. m. It is not included in the census of 1870. The surface consists chiefly of undulating prairies.

**STAFFORD,** the county town of Staffordshire, England, on the left bank of the Sow, 125 m. N. W. of London; pop. in 1871, 14,437. The town is situated on low ground, and is mainly well built of stone or brick. A Norman castle, several times demolished and rebuilt, once occupied a commanding position not far distant. Since 1810 a massive castellated structure has occupied its place. Among the prominent public buildings are the county hall, a jail, infirmary, lunatic asylum, library, and mechanics' institute. A free grammar school was established in 1556. The church of St. Mary is the most costly and conspicuous. The Trent Valley railway and a canal are near. There are extensive manufactures of leather, boots and shoes, and cutlery. Public markets are held for the sale of cattle, horses, wool, and cheese.

**STAFFORD, Henry,** duke of Buckingham. See BUCKINGHAM, EARLS AND DUKES OF.

**STAFFORD, William Howard,** viscount, an English statesman, born Nov. 30, 1612, executed on Tower hill, Dec. 29, 1680. He was the second son of Thomas, earl of Arundel, and in right of his wife, as successor of her brother, was created Baron Stafford, and in November, 1640, Viscount Stafford. He was brought up in the Roman Catholic faith, and adhered during the civil war to the royal cause; but after the restoration he was frequently in opposition to the court. He was singled out by Titus Oates, the contriver of the "popish plot," as one of his chief victims. Oates deposed before the house of commons that upon the subversion of the kingdom by the Jesuits Lord Stafford was to be paymaster of the army; and the accused nobleman was committed to the tower, Oct. 30, 1678, with several other Catholic peers. After two years his trial for alleged high treason began, Nov. 30, 1680, lasting a week. He defended himself with ability, shaking confidence in Oates's evidence; but Dugdale and Tuberville swore so positively that Stafford had incited them to assassinate the king, that a verdict of guilty was pronounced by a vote of 55 to 31. He was executed three weeks afterward; but the popular feeling so changed after his trial that when he protested his innocence on the scaffold the spectators cried: "We believe you, my lord. God bless you, my lord." His eldest son was created earl of Stafford.

**STAFFORDSHIRE,** an inland and nearly central county of England, bordering on the counties of Chester, Derby, Leicester, Warwick, Worcester, and Salop; area, 1,138 sq. m.; pop. in 1871, 858,326. The river Trent traverses it in a S. E. direction, and has several considerable tributaries. Much of the surface consists of moorlands, elevated in some places 1,000 ft. above the sea. Staffordshire is an important manufacturing county, and coal, iron, copper, and lead mines are worked extensively. The leading manufactures are iron, hardware, and earthenware, of which last it is the chief seat in England, and which gives name to a division of the county called the Potteries. The pottery works established by Josiah Wedgwood are in this county. The ale breweries of Burton-upon-Trent are very extensive and celebrated, and there are cotton mills, glass works, and tanneries. The county has a network of roads, canals, and railways. The principal towns are Stafford, the capital, Lichfield, Burton-upon-Trent, Wolverhampton, Dudley, Tamworth, Walsall, Uttoxeter, Stoke-upon-Trent, Hanley, Burslem, and Newcastle-under-Lyme.

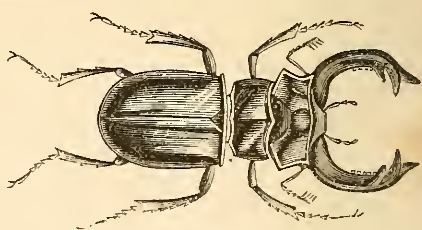
**STAG,** the common name of the red deer of Europe (*cervus elaphus,* Linn.) and its congeners. It is about 4 ft. high at the shoulders, and of a general reddish brown color, tinged with grayish in the winter; on the rump is a pale spot extending a little above the tail; there is a blackish dorsal line, and on each side often a row of pale fulvous spots; the hair is brittle, and in old animals forms a kind of mane on the neck; the tail is moderate, the tear bag well developed, suborbital pit large, and the hoofs narrow, triangular, and compressed. The antlers are large and rounded, with an anterior basal and a median anterior snag, and the apex divided into two or more branches

according to age; they are peculiar to the males, shed in the spring, and reproduced, sometimes to a weight of 24 lbs., by August. (For family characters see DEER.) It is strong,

Stag (Cervus elaphus).

swift, and vigilant, with a very acute sense of smell; it was formerly found in herds in the forests of the mountainous regions of temperate Europe, but is now rare except in the least inhabited parts, like the highlands of Scotland, where stag hunting is still a favorite sport with the privileged few. This in old times constituted the noble art of *venerie*, as distinguished from the more plebeian chase of the fallow deer and other species which resort to the plains more than the woods. Gestation continues eight months; the young or calf is dropped in May, and is yellowish with white spots; the male is called a stag or hart, and the female a hind. The venison is coarser than that of the fallow deer. It has been found fossil, with bones of the elephant and other ungulates, in the Kirkdale cavern, the peat bogs of Ireland, and similar recent formations. It is represented in North America by the larger wapiti. (See WAPITI.) Other stags are found in India, N. Africa, and Japan.

**STAG BEETLE**, the common name of the family *lucanidæ*, of the lamellicorn pentamerous coleoptera, of which the type is the genus *lucanus* (Linn.). Many of the species are of considerable size, and have received their name from the large and powerful mandibles with which the males are furnished. The stag beetle of Europe (*L. cervus*, Linn.) is 2 in. long, exclusive of the mandibles, and is the largest and most formidable of the British beetles; the color is black, with brown elytra; the head is wider than the body; the mandibles corneous, arched, with three large and several smaller teeth, and used as instruments of offence; antennæ bent, pectinated, and 10-jointed, tibiæ dentated along outer edge, and the tarsi ending in two hooks. They live in the trunks of trees by day, flying abroad at night, often into houses; the females are smaller, with narrower head and much shorter mandibles. They are also called horn beetles and flying bulls. According to De Geer, they feed principally on the sweet juice spread over the leaves of the oak and exuding on the bark, which they obtain by means of the brushes of the under jaws; they are said to seize caterpillars and soft-bodied insects, and to suck their juices; they are very strong, and can pinch the finger pretty hard, but do not use their mandibles in this way unless provoked, and their punctures are not poisonous; they live only a short time in the perfect state, perishing soon after laying their eggs in the crevices of bark near the roots of trees. The larvæ are large and fleshy grubs with very thick body, arched, with 13 rings, and having a brown scaly head armed with two strong jaws with which they gnaw wood, reducing it to a coarse powder, and often doing much damage by boring into the trunks and roots of oaks and beeches; there are six scaly feet, attached to the first three rings; they are said to be six years in coming to their growth, and by some are regarded as the *cossus* of the Romans, a worm-like grub, according to Pliny, obtained from the oak and considered



European Stag Beetle (Lucanus cervus).

delicious food. The largest of the New England species is the *L. capreolus* (Linn.), usually called horn bug; it is about 1¼ in. long, without the mandibles, the latter being sickle-shaped and toothed; the body mahogany brown, smooth and polished. They appear in July and August. The larvæ are 3 in. long when full grown, straw-colored, with yellow head, brown jaws, and nine stigmata; they live in the trunks and roots of apple trees, willows, and oaks, and are sometimes injurious.

**STAG HOUND.** See HOUND.

**STAGIRA**, previously **Stagirus**, an ancient town of Macedonia, in Chalcidice, on the Strymonic gulf. It was founded by a colony from Andros in the middle of the 7th century B. C., and was originally named Orthagoria. It was destroyed and rebuilt by Philip, the father of Alexander. It is chiefly known as the birthplace of Aristotle.

**STAHL, Friedrich Julius**, a German jurist, born in Munich, Jan. 16, 1802, died at Brückenau, near Kissingen, Aug. 10, 1861. He was of a Jewish family named Schlesinger, but adopted the name Stahl in 1819 on becoming a Christian. He was professor of law at Erlangen and Würzburg, and from 1840 at Berlin. In 1848 he founded with Bethmann-Hollweg the German church diet, of which he was vice president till 1859, and was a leader of the high Lutheran party. As a member of the Prussian chamber of deputies (1849), of the Erfurt parliament (1850), and from 1854 of the upper house of the Prussian legislature, he advocated feudal principles. His most important work is *Philosophie des Rechts* (2 vols., Heidelberg, 1830–'37), in which he develops his famous theory of a "Christian state," which is to aid the church by the secular arm in extending Christianity. In *Die Kirchenverfassung*, &c. (Erlangen, 1840), he declared himself in favor of an episcopal form of church government. In 1855 he had a controversy with Chevalier Bunsen, which attracted general attention in literary circles. His last great work was *Die lutherische Kirche und die Union* (Berlin, 1859).

**STAHL, Georg Ernst**, a German chemist, born in Anspach, Oct. 21, 1660, died in Berlin, May 14, 1734. He took his degree at Jena in 1684, and after giving private lectures there, he was physician to the duke of Weimar from 1687 to 1694, and subsequently professor at Halle till 1716, when he settled in Berlin with the title of royal physician. He was among the first to raise chemistry to an equality with the other natural sciences. In his *Theoria Medica Vera* (Halle, 1707; new ed. by Choulant, 3 vols., Leipsic, 1831–'3; translated into German by Ideler, 3 vols., Berlin, 1832–'3) he supposed the existence of an *anima* or immaterial principle resident in the body, creating its organization, and governing all its processes with reference to the final purpose of preserving life. Every corporeal movement, he said, is the product of a spiritual order. He elaborated also the phlogistic theory which prevailed till the time of Lavoisier, and gave it its name, although its principles had been previously broached by Becher (see HEAT, vol. viii., p. 567), in development and defence of which he published *Zymotechnia Fundamentalis* (1697), and *Experimenta et Observationes Chemicæ* (1731). His works have been translated into French, with commentary by T. Blondin (*Œuvres médico-philosophiques et pratiques*, Paris, 1858 *et seq.*).—See *Le vitalisme et l'animalisme de Stahl*, by A. Lemoine (1864), and CHEMISTRY, vol. iv., p. 360.

**STAHR, Adolf Wilhelm Theodor**, a German author, born in Prenzlau, Prussia, Oct. 22, 1805, died Oct. 3, 1876. He completed his studies at Halle, in 1826 became a teacher there, subsequently taught in the gymnasium in Oldenburg, and in 1852 settled in Berlin. In 1855 he married the authoress Fanny Lewald. His works include *Aristotelia* (2 vols., 1830–'32); *Ein Jahr in Italien* (3 vols., 1847–'50); *Die preussische Revolution* (1850; 2d ed., 1852); *Torso, oder Kunst, Künstler und Kunstwerke der Alten* (2 vols., 1854–'5; English translation in the "Crayon," New York, 1858–'9); *G. E. Lessing, sein Leben und seine Werke* (2 vols., 1859; 6th ed., 1869; English translation, Boston, 1866); *Herbstmonate in Oberitalien* (1859; 2d ed., 1871); *Bilder aus dem Alterthum* (4 vols., 1863–'6); with his wife, *Ein Winter in Rom* (1869; 2d ed., 1871); *Lebenserinnerungen* (1870 *et seq.*); *Tacitus' Geschichte der Regierung des Kaisers Tiberius übersetzt und erklärt* (1871); *Goethe's Frauengestalten* (for Kaulbach's *Goethe-Gallerie*; 4th ed., 2 vols., 1872); and *Tiberius' Leben, Regierung und Charakter* (1874). A collective edition of his works was commenced at Berlin in 1871.

**STAIR, Lord.** See DALRYMPLE.

**STAMFORD**, a town and borough of Fairfield co., Connecticut, on Long Island sound and the New York and New Haven and New Canaan and Stamford railroads, 34 m. N. E. of New York; pop. in 1870, 9,714. The town extends from the sound N. W. to the New York state line, a distance of 10 m., in which there is a series of elevations running N. E. and S. W., affording sites for four villages, High Ridge, Long Ridge, Hunting Ridge, and North Stamford. The greater part of the population resides in the borough of Stamford, which has a small harbor, made accessible to steamboats by a canal. The borough is supplied with water brought 10 m., is lighted with gas, and has paved sidewalks. The nearness to New York, attractive scenery, and wholesome air have made the town the residence of many business men from that city. The chief factories are the Stamford manufacturing company, producing extract of logwood, liquorice, &c.; a lock factory, a billiard table factory, a woollen mill, a stove foundery, a carriage factory, rolling mills, camphor refineries, and manufactories of shoes, fire brick, edge tools, wire, &c. The town contains two national banks, two savings banks, 16 public schools, including a high school, two weekly newspapers, and 14 churches.

**STAMMERING**, a term generally applied to all kinds of defective utterance, but more correctly restricted to the organic or symptomatic defects, in distinction from stuttering, which is properly an idiopathic or functional difficulty. Both stammering and stuttering may nevertheless be treated under the common title. The causes which lead to stammering are usually, though not always, organic; harelip, cleft palate, elongation of the uvula, enlargement of the tonsils, a deficiency or unusual position of the teeth, tumors of the tongue or cavity of the mouth, and inflammation or ulceration of the parotid glands, are the most frequent of these causes. Where the defect results from functional disturbance, its principal causes are general debility, paralysis either local or general, tetanic or other

spasms; a rheumatic or neuralgic affection of the muscles of the face, jaw, tongue, lips, &c., or of the vocal cords; a condition of intoxication; chorea; or in some cases a habitual imitation of stammering. Occasional stammering may be produced by a temporary confusion of mind, without any anatomical defect of the vocal organs. Stuttering is seldom or never organic. The stutterer is often in perfect health, and the vocal organs are not in any way diseased or deformed. His difficulty consists in the momentary inability to pronounce certain words or syllables. The stoppage of sound usually takes place at the first syllable, though occasionally at the second or third. Words beginning with *k*, *t*, *g*, *d*, *p*, *b*, or *m* usually give the stutterer the most trouble, because they require the closing of the lips or the pressing of the tongue against the roof of the mouth for their enunciation, and an immediate reopening for the vowel which follows; while he keeps the lips closed, and compresses the cavity of the mouth in the attempt to force out the sound. Most stutterers can sing without difficulty, the action of the vocal organs being much less frequently interrupted in singing than in speaking. Stutterers may be classed under two heads, mental or psychical and physical. Under the stimulus of pleasant or joyful emotions, the first class experience little difficulty in conversation; under depressing influences, their utterance is seriously disturbed. The physical stutterer is rendered worse by unpleasant weather, great fatigue, vicious indulgence, and the excessive use of tobacco or alcoholic drinks. The number of bad stammerers is estimated by Colombat at 1 in 5,000; but the number having some degree of impediment is not probably less than 1 in 500. Only about one tenth of these are females.—The proper treatment of either stuttering or stammering is indicated by the cause which induces it. In the case of the stammerer there should be a thorough investigation for an organic cause. The clipping of the uvula, the removal of a portion of the tonsils, or the excision of a wedge-shaped piece from a tongue too large for the mouth, the use of electrical or other remedies for the cure of paralysis, the cauterization of ulcers in the mouth, the removal of irregular or the insertion of false teeth, and the administration of tonics for debility, have each resulted in the cure of cases of stammering; but no one of these will answer for all or perhaps a majority of cases. In stuttering also, the cause will indicate to some extent the method of cure. The muscles must be educated to uniform obedience to the will, and the will trained to steady and intelligent control over the muscles and nerves. A course of lessons in enunciation, by a capable teacher, will often effect a complete cure. Dr. J. M. Warren of Boston lays down the rules that treatment for impediments of speech should be commenced between the ages of 8 and 12; and that "little permanent advantage will be gained, in the majority of cases, unless the treatment be resolutely persevered in for one or two years."

**STAMP ACTS,** laws for the raising of revenue by requiring the use of government stamps on the paper or parchment by means of which business is transacted or privileges conferred, or upon packages of goods put up for sale, &c. Such laws were introduced into England, in the reign of William and Mary, from Holland, and from that time to the present have been a favorite mode of raising revenue. Each stamp represents a tax of a certain sum which must be paid to obtain it, and its payment is enforced by imposing penalties on those who undertake to evade the tax, and by declaring the transaction in which it should have been made use of invalid if the stamp is not obtained and used. The name of stamp act was made odious in America by the attempt in 1765 to tax the colonies in this form; but after the Union was perfected by means of the constitution a few stamp duties were for a time laid. During the civil war of 1861–'5 stamp taxes were laid on almost every form of legal instrument, bank drafts and checks, conveyances of land, &c., and on the packages of a great variety of manufactured goods. Many of these have since been taken off, but the stamp taxes on manufactures are generally retained. (See TAXES.)

**STANCHIO.** See Cos.

**STANDISH, Miles,** a soldier of New England, born in Lancashire, England, about 1584, died in Duxbury, Mass., Oct. 3, 1656. He had served in the Netherlands, and on coming to Plymouth with the first company in 1620 he was chosen captain by the pilgrims, though not a member of their church. He had great courage, energy, and determination, with a fiery temper, and rendered important services to the early settlers. He commanded frequent expeditions against the savages who annoyed the settlements, and by the boldness and skill of his attacks inspired them with great awe of his military prowess. He visited England in 1625 as an agent for the colony, and brought supplies in 1626. He then settled at Duxbury, and for the remainder of his life held the office of magistrate or assistant for that town. In 1649 he took part in the settlement of Bridgewater. The corner stone of a monument to his memory was laid on Captain's Hill, Duxbury, Oct. 7, 1872. The singular circumstances of his marriage are the subject of a celebrated poem by Longfellow, "The Courtship of Miles Standish."

**STANFIELD, Clarkson,** an English painter, born in Sunderland about 1798, died at Hampstead, May 18, 1867. He followed the sea in early life, and was afterward distinguished as a theatrical scene painter. In 1827 he exhibited at the British institution his first large picture, "Wreckers off Fort Rouge;" in 1832 he was elected an associate of the royal academy, and in 1835 an academician. He painted nearly

every kind of landscape, but as a painter of sea pieces he enjoyed a unique reputation. His works include "Wreck of a Dutch East Indiaman on the Coast of Holland;" "The Victory, bearing the Body of Nelson, towed into Gibraltar;" "The Abandoned;" "The Battle of Trafalgar;" "The French Troops fording the Magra;" "The Battle of Roveredo;" "The Pyrenees;" and "St. Sebastian during the Siege under the Duke of Wellington." Among his latest works were "The Worm's Head" (1864), and "The Bass Rock" (1865). He was a prolific designer for illustrated works, and published a series of lithographic copies of his sketches, "The Moselle, the Rhine, and the Meuse" (fol., 1838).

**STANFORD, John**, an American clergyman, born at Wandsworth, England, Oct. 20, 1754, died in New York, Jan. 14, 1834. He was brought up in the church of England, but united with the Baptist church, and in 1786 emigrated to the United States, spent a few months at Norfolk, Va., and then opened an academy in New York. In 1787 he became pastor of the first Baptist church, Providence, R. I., and while there wrote a history of that church. He resumed teaching in New York in 1789, and a Baptist church having been formed through his exertions in 1794, he served as its pastor till about 1800, continuing his school till 1813. He published "The Domestic Chaplain" (1806); "Description of New York City" (1814); and "The Aged Christian's Companion" (1829).

**STANHOPE. I. James**, earl, a British statesman, born in 1673, died in London, Feb. 5, 1721. He was the son of Alexander Stanhope, a brother of the second earl of Chesterfield. Entering the military service at an early age, he was in 1694 commissioned a captain in the foot guards. After serving in Flanders till the peace of Ryswick, he participated in the disastrous expeditions of 1702 and 1704 to the Spanish peninsula; and in 1705, being then a brigadier general, he shared in the earl of Peterborough's brilliant Spanish campaign. In 1706 he was sent by Queen Anne as envoy extraordinary to the king of Spain (the archduke Charles). In 1707 he was made major general, and in 1708 commander-in-chief of the British forces in Spain, and reduced Minorca and captured Port Mahon. After gaining further important successes in Spain, he was surprised by the duke of Vendôme at Brihuega on Dec. 8, 1710, and forced to surrender next day with about 4,000 men. Returning to England, he took his seat as a whig in parliament, to which he had been regularly returned since 1702. George I. on his accession appointed him one of his principal secretaries of state, Viscount Townshend being the other. In April, 1717, he was made first lord of the treasury, and a few months afterward raised to the peerage as Baron Stanhope of Elvaston and Viscount Stanhope of Mahon. In 1718 he resumed his office of secretary, Sunderland becoming first lord of the treasury, and was created Earl Stanhope. He went to Paris and Madrid to avert hostilities with Spain, but without success; and he was afterward employed in similar missions. On Feb. 4, 1721, while replying with much heat to an attack upon the ministry by the duke of Wharton, he burst a blood vessel. **II. Charles**, third earl, grandson of the preceding, born in August, 1753, died in December, 1816. Succeeding to his family honors in 1786, he became noted for his radical opinions, and in his discussions carried the principles of the whigs so far that none of them dared follow him; and in the latter years of his life he used to be called "the minority of one." He invented the printing press which bears his name, suggested improvements in canal locks, and contrived two calculating machines. He also studied electricity, and in 1779 published his theory of what is called the return stroke. His principal works are a reply to Burke's "Reflections on the French Revolution," and an "Essay on Juries." **III. Philip Henry**, fifth earl, an English author, grandson of the preceding, born at Walmer, Kent, Jan. 31, 1805, died at Bournemouth, Hampshire, Dec. 24, 1875. He graduated at Oxford in 1827, and from 1830 to 1852 was a member of parliament under his courtesy title of Lord Mahon. He held office during brief periods in the cabinets of the duke of Wellington and Sir Robert Peel, and he introduced and carried the copyright act of 1842. He has published "Life of Belisarius" (8vo, 1829); "History of the War of Succession in Spain" (8vo, 1832); "History of England from the Peace of Utrecht to the Peace of Versailles, 1713–'83" (7 vols., 1836–'54); "Spain under Charles II." (8vo, 1840); "Life of Louis, Prince of Condé" (18mo, 1845); "Historical Essays contributed to the Quarterly Review" (8vo, 1849); a "Life of Joan of Arc" (1853); a "Life of William Pitt" (4 vols. 8vo, 1861–'2); and "History of England, comprising the Reign of Anne, until the Peace of Utrecht" (1870). He has edited "The Letters of Philip Dormer Stanhope, Earl of Chesterfield" (1845; 2d ed., 5 vols. 8vo, 1853), in conjunction with Mr. Cardwell, and "Memoirs by the Right Hon. Sir Robert Peel, Bart." (2 vols., 1856–'7). Lord Stanhope succeeded to his title in 1855. Since 1846 he has been president of the society of antiquaries. In 1858 he was elected lord rector of the university of Aberdeen, and in 1872 one of the six foreign members of the academy of moral and political sciences at Paris, in place of Mr. Grote.

**STANHOPE, Lady Hester Lucy**, an eccentric English woman, born in London, March 12, 1776, died at Jun, in the Lebanon, June 23, 1839. She was the eldest child of Charles, third Earl Stanhope, by Hester, daughter of the great earl of Chatham. When about 20 years of age she entered the family of her uncle William Pitt, with whom she lived until

his death in 1806, acting as his private secretary and sharing his confidences. Pitt having recommended his niece to the care of the nation, she received a pension of £1,200, which proving inadequate to support her according to her former rank and style, she retired to solitude in Wales. Indulging in dreams of a great destiny in the Orient, she repaired in 1810 to Syria, and visited Jerusalem, Damascus, Baalbec, and Palmyra. The Arabs, who were struck by her powers and display of wealth, treated her as a queen, and she skilfully acted the part of a modern Zenobia. She established herself in 1813 at the deserted convent of Mar Elias, beside the little village of Jun, and within eight miles of Sidon. Here, wearing the dress of an emir, weapons, pipe, and all, she ruled her Albanian guards and her servants with absolute authority. The old convent, perched upon an isolated eminence among the wildest scenery of the Lebanon, was soon converted into a fortress, garrisoned by Albanians, and became a refuge to all the persecuted and distressed who sought her assistance. So powerful was the influence which she wielded in the surrounding country, that Ibrahim Pasha, when about to invade Syria in 1832, was constrained to solicit her neutrality. After the siege of Acre in the same year, she is said to have sheltered several hundred refugees. She practised astrology and other secret arts, and promulgated some peculiar religious sentiments which she held to the last. That her mind was diseased on certain points is clear from the fact that she kept in a magnificent stable two mares, on which she fancied she was to ride into Jerusalem with the Messiah at his next coming. During the latter years of her life she was constantly harassed by debts, and she died with no European near her, and surrounded by a crowd of native servants, who plundered the house almost before life had left her body. She was buried in the garden adjoining her residence. Her "Memoirs as related by Herself" (3 vols. 8vo), and "Travels" (3 vols. 8vo) by Dr. Meryon, who had been her physician for several years, were published soon after her death.

**STANHOPE, Philip Dormer.** See CHESTERFIELD.

**STANISLAS I. LESZCZYNSKI,** king of Poland, born in Lemberg, Galicia, Oct. 20, 1677, died in Lunéville, France, Feb. 23, 1766. He was palatine of Posen, and had held an office at the Polish court, where he won the friendship of Charles XII. of Sweden, who in 1705, after defeating Augustus II., procured his election to the throne of Poland; but he lost the crown by Charles's defeat at Poltava in 1709, when Augustus was restored. While attempting to join Charles at Bender, Stanislas was in 1713 taken prisoner by the hospodar of Moldavia and delivered to the Turks; released in 1714, he served as governor of Zweibrücken till the death of Charles XII. in December, 1718. The regent Philip of Orleans now granted him a pension and permission to reside at Weissenburg, Alsace. His prospects improved in 1725 through the marriage of his daughter Maria with Louis XV., who initiated, after the death of Augustus II. in 1733, a war for the Polish succession; but Augustus III. retained the throne through Russian intervention, although Stanislas had been reëlected as king. The latter was obliged to retire to Dantzic, where he was besieged by a Russian army, and after a bold resistance of several months escaped in June, 1734. In accordance with the preliminary peace of 1735 he resigned his claims to the Polish throne, but retained his royal title, recovered his estates, and received Lorraine and Bar, which after his death were to be united to France; and in the interval he received a pension of 2,000,000 francs for relinquishing the revenues of those duchies. His brilliant court at Lunéville and Nancy became celebrated through his munificent patronage of public and charitable works, of letters and art, and through his associations with Voltaire and other eminent personages. Nancy is indebted to him for her finest monuments, and he was styled *le bienfaisant.* His death was caused by his garments taking fire while he was reading. His essays on philosophy, politics, and morals have been printed under the title of *Œuvres du philosophe bienfaisant* (4 vols. 8vo and 4 vols. 12mo, 1765).

**STANISLAS AUGUSTUS,** king of Poland. See PONIATOWSKI, and POLAND, vol. xiii., p. 647.

**STANISLAUS,** a central county of California, bounded N. in part by the Stanislaus river, and intersected by the San Joaquin and Tuolumne; area, 1,350 sq. m.; pop. in 1870, 6,499, of whom 306 were Chinese. It is for the most part level, but the E. portion is undulating, while a strip a few miles wide on the W. border rises into the Coast range, which here has a general altitude of about 2,000 ft. There is little timber. The soil is very productive. Gold mining is carried on to some extent in the E. part. It is traversed by the Visalia division of the Central Pacific railroad. The chief productions in 1870 were 1,650,725 bushels of wheat, 15,700 of Indian corn, 632,950 of barley, 749,263 lbs. of wool, 52,625 of butter, and 15,191 tons of hay. There were 10,137 horses, 1,139 mules and asses, 2,271 milch cows, 4,316 other cattle, 118,460 sheep, and 14,593 swine. Capital, Modesto.

**STANKO.** See COS.

**STANLEY.** I. A S. W. county of North Carolina, bounded E. by the Yadkin and S. by Rocky river; area, about 300 sq. m.; pop. in 1870, 8,315, of whom 1,289 were colored. The surface is mountainous and the soil generally fertile. Gold and silver have been found in considerable quantities. The chief productions in 1870 were 63,575 bushels of wheat, 118,788 of Indian corn, 42,037 of oats, 10,435 of sweet and 5,294 of Irish potatoes, 12,459 lbs. of tobacco, 8,294 of wool, 20,164 of honey, and 11,515 gallons of sorghum molasses. There

were 1,333 horses, 332 mules and asses, 1,725 milch cows, 2,963 other cattle, 5,705 sheep, and 9,349 swine. Capital, Albemarle. **II.** A S. W. county of Dakota, recently formed and not included in the census of 1870; area, about 1,450 sq. m. It is bounded N. E. by the Missouri river, and is intersected by the Big Cheyenne and Titon rivers, tributaries of the Missouri. The surface is rolling.

**STANLEY, Arthur Penrhyn,** an English clergyman, born in Alderley, Cheshire, Dec. 13, 1815. His father was Dr. Edward Stanley (1779–1849), rector of Alderley for 32 years, bishop of Norwich from 1837, and author of "Familiar History of Birds" (2 vols., 1835), &c. The son was educated at Rugby, and in 1838 graduated at University college, Oxford, where he subsequently resided for 12 years as tutor. In 1851 he was appointed canon of Canterbury, and he was regius professor of ecclesiastical history at Oxford from 1856 to 1864, when he was made dean of Westminster. He is a leader of the "Broad Church" party. He has published "Life and Correspondence of Thomas Arnold, D. D." (2 vols. 8vo, 1844), which has passed through numerous editions, and been translated into several foreign languages; "Sermons and Essays on the Apostolical Age" (1847); "The Epistles of St. Paul to the Corinthians, with Critical Notes and Dissertations" (2 vols. 8vo, 1855; 4th ed., 1874); "Historical Memorials of Canterbury Cathedral" (8vo, 1855; 5th ed., 1869); "Sinai and Palestine, in Connection with their History" (8vo, 1856; 20th ed., 1874); "Lectures on the History of the Eastern Church" (8vo, 1861); "Lectures on the History of the Jewish Church" (part i., Abraham to Samuel, 1862; part ii., Samuel to the Captivity, 1865; part iii., 1876); "The Bible, its Form and Substance" (1862); "Scripture Portraits, and other Miscellanies" (1867); "Historical Memorials of Westminster Abbey" (1867; 4th ed., 1874); "The Three Irish Churches," a historical address (1869); "Essays on Church and State" (1870); "The Athanasian Creed" (1871); and "Lectures on the History of the Church of Scotland" (1872). In November, 1874, he was elected lord rector of the university of St. Andrews.

**STANLEY, Edward Henry Smith,** lord. See Derby, earl.

**STANLEY, Henry M.,** an American traveller, born near Denbigh, Wales, in 1840. His original name was John Rowlands. At the age of three he was sent to the poorhouse at St. Asaph, where he remained till he was 13, receiving there a good education. For a year he was a teacher at Mold, Flintshire, and then shipped at Liverpool as a cabin boy on a vessel bound to New Orleans. There he found employment with a merchant named Stanley, who subsequently adopted him and gave him his name. His benefactor died intestate, and young Stanley at the outbreak of the civil war enlisted in the confederate army, was taken prisoner, volunteered in the United States navy, and subsequently became an acting ensign in the iron-clad Ticonderoga. After the close of the war he travelled in Turkey and Asia Minor, and in 1866 visited Wales. He gave a dinner to the children in St. Asaph poorhouse, telling them in a speech that whatever success he had attained, or would attain in the future, he owed to the education he received there. In the spring of 1867 he returned to the United States, and in 1868 accompanied the British expedition to Abyssinia as correspondent of the "New York Herald." In 1869 he was sent to Spain in the same capacity, and on Oct. 17 of that year was commissioned by the proprietor of the "Herald" to find Dr. Livingstone. After attending the opening of the Suez canal, he visited Constantinople, Palestine, the Crimea, the valley of the Euphrates, Persia, and India, and sailed from Bombay Oct. 12, 1870. He arrived at Zanzibar Jan. 6, 1871, and set out for the interior of Africa on March 21, with 192 followers. He found Dr. Livingstone at Ujiji on Lake Tanganyika, Nov. 10, explored with him the northern portion of the lake, and began his return voyage on March 14, 1872. He arrived in England late in July, and gave an account of his expedition before the British association at Brighton, Aug. 16. On Aug. 27 the queen sent him a gold snuff box set with diamonds, and on Oct. 21 he was banqueted by the royal geographical society. In November he published "How I found Livingstone" (London and New York). In 1873 he received the patron's medal of the royal geographical society. After the death of Livingstone, Mr. Stanley was commissioned by the proprietors of the "New York Herald" and the London "Telegraph" to explore the lake region of equatorial Africa. As reported in his letters to those journals, he left the coast in November, 1874, at the head of 300 men, diverged from the usual road at Upwapwa, reached the western frontier of Ugongo on Dec. 31, struck direct across an almost level plain, and at Tchiwyu, in the Urimi country, about the latitude of Ujiji, he found the waters flowing northward. Thence he followed the course of the river Shemeeyu for 350 m., and reached Kagehyi, on the Victoria N'yanza lake, Feb. 27, 1875, having lost 194 men by death and desertion. He launched a boat conveyed in pieces from the coast, and circumnavigated the lake, assisted by 30 canoes lent him by Mtesa, king of Uganda. His circumnavigation covered about 1,000 m.; he minutely explored the inlets, and found that the opinion of Burton and Livingstone, based on native reports, that N'yanza is a collection of lagoons, is wrong, and that Speke and Grant were right in declaring it to be one large lake, containing many islands. On April 17 he started to complete his exploration of the W. side of the Victoria N'yanza. He proposed next to cross the intervening country and explore the Albert N'yanza.

**STANLEY, Thomas,** an English author, born in Hertfordshire in 1625, died in London, April 12, 1678. He was educated at Cambridge, and resided for several years in the Middle Temple. He published "Poems and Translations" (1649); "History of Philosophy, containing the Lives, Opinions, Actions, and Discourses of the Philosophers of every Sect" (3 vols. fol., 1655–'62; Latin translation by Olearius, Leipsic, 1711); and an edition of Æschylus with a commentary and a Latin version (1663; new ed. by Dr. Butler, 4 vols. 4to, Cambridge, 1809). In 1814–'15 appeared an edition of his poems with a biographical memoir by Sir Egerton Brydges.

**STANSTEAD,** a S. county of Quebec, Canada, bordering on Vermont; area, 407 sq. m.; pop. in 1871, 13,138, of whom 5,763 were of English, 3,212 of French, 2,599 of Irish, 1,016 of Scotch, and 408 of German origin or descent. It contains Lake Massawippi and a part of Lake Memphremagog, and is traversed by the Stanstead, Shefford, and Chambly, the Massawippi Valley, and the Grand Trunk railways. Capital, Stanstead.

**STANTON. I.** A N. E. county of Nebraska, intersected by Elkhorn river; area, 432 sq. m.; pop. in 1870, 636; in 1875, 1,157. The surface consists chiefly of rolling prairies. The chief productions in 1870 were 15,640 bushels of wheat, 9,255 of Indian corn, 6,548 of oats, 3,630 of potatoes, 8,645 lbs. of butter, and 943 tons of hay; value of live stock, $27,521. Capital, Stanton. **II.** An unorganized S. W. county of Kansas, bordering on Colorado; area, 720 sq. m. It is drained by tributaries of the Arkansas river. The surface is rolling.

**STANTON, Edwin McMasters,** an American statesman, born in Steubenville, Ohio, Dec. 19, 1814, died in Washington, D. C., Dec. 24, 1869. He was a student in Kenyon college from 1831 to 1833, was admitted to the bar in 1836, began practice in Cadiz, Harrison co., Ohio, and soon afterward was elected prosecuting attorney for the county. After acquiring a large circuit practice he removed to Steubenville. From 1842 to 1845 he was reporter of the decisions of the supreme court of the state, and prepared vols. xi., xii., and xiii. of the Ohio reports. In 1845 he successfully defended Caleb J. McNulty, clerk of the house of representatives, tried in the criminal court of Washington for embezzlement. In 1847 he removed to Pittsburgh, Pa., but for nine years afterward retained also an office in Steubenville. His first appearance before the supreme court of the United States was as counsel for Pennsylvania in the case of the state against the Wheeling and Belmont bridge company, and thereafter his practice in that court increased so much that in 1856 he removed to Washington. In 1858 he went to California as counsel for the government in certain land cases, and his services were specially important in the examination of Spanish and Mexican archives in their bearing upon titles. He was also engaged in several leading patent cases. In 1859 he was one of the counsel for Daniel E. Sickles, tried for the murder of Philip Barton Key. In December, 1860, he was nominated attorney general of the United States, and served to the close of President Buchanan's administration, when he resumed the practice of his profession. In January, 1862, he was appointed secretary of war. His labors in this department were indefatigable, and many of the most important and successful movements of the war were originated by him. He continued as secretary after the succession of Andrew Johnson; but his support of congressional measures which were vetoed and repassed, and his opposition to Johnson's plan of reconstruction, led the president (from whom the power of removal had been taken by the tenure of office act), on Aug. 5, 1867, to request his resignation. He refused to resign, but on Aug. 12 he gave way under protest to Gen. Grant as secretary *ad interim.* On Jan. 13, 1868, the senate reinstated him. On Feb. 21 the president appointed Gen. Lorenzo Thomas secretary of war *ad interim*, and Mr. Stanton refusing to vacate, the impeachment of the president followed. (See JOHNSON, ANDREW.) Upon the president's acquittal, May 26, Mr. Stanton resigned. The senate in confirming his successor adopted a resolution that Mr. Stanton was not legally removed, but relinquished his office; and subsequently congress passed a vote of thanks to him for the great ability, purity, and fidelity with which he had discharged his duties. Although his health was much shattered by his arduous labors in the war department, his circumstances compelled him to resume the practice of the law, and he argued several important cases. On Dec. 20, 1869, he was nominated by President Grant as an associate justice of the supreme court of the United States, and was immediately confirmed by the senate; but he died after a brief illness from dropsy, before his commission was made out.

**STAR** (Gr. ἀστήρ, ἄστρον), a luminous body beyond the solar system, not nebulous. The study of the stars includes two chief divisions: 1, the determination of the exact position and changes of position of individual stars; 2, the inquiry into the laws according to which the stars are distributed throughout space, or rather throughout that portion of space within which, by means of the telescope, astronomers are able to carry on their researches. In the infancy of astronomy the stars were divided into constellations, chiefly for the sake of convenient reference, though partly also, as we learn from Aratus, Manilius, and others, because of fanciful ideas connected with mythological and astrological superstitions. Unfortunately, this rough and imperfect method of distributing the star groups has continued to our own time, but with a modification of the method of indicating particular stars. Originally the brighter stars received different names; but Bayer introduced the plan of assigning to the

stars of each constellation, in the order of their brightness, the letters of the Greek alphabet. Since his day cataloguers of stars have introduced several new methods, more or less incongruous. For instance, Flamsteed numbered the stars in each constellation according to their right ascension in his time; Piazzi numbered stars in hours of right ascension, the first in each hour being called 1, the next 2, and so on; W. Struve numbered all the stars he dealt with (in forming a catalogue of double stars), from 0h. 0m. 0s. onward, till the complete circuit of the sphere had been made in right ascension; variable stars have received the letters R, S, T, &c., for each constellation, in order of discovery, the letters A, B, C, &c., from the other end of the alphabet, having been already employed in continuation of Bayer's system; and still other methods have been introduced, to the confusion of learners. Moreover, the regions occupied by the different constellations have not been definitely assigned; some astronomers include the new constellations added by Bode and others, while many only allow the constellations of Ptolemy, Hevelius, and Halley (in the southern hemisphere) to appear in the maps, omitting generally the constellations Antinous, Cerberus, and Scutum Sobieskii from Hevelius's list, and Robur Carolinum from Halley's. Similar confusion exists as respects the method of indicating the brightness of stars. Astronomers agree in dividing the stars visible to the naked eye into six orders of brightness called magnitudes, from the first magnitude or brightness to the sixth, the faintest which ordinary eyesight can perceive in dark and clear nights without telescopic aid; but for the fainter or telescopic stars four different methods of classification have been employed by Sir J. Herschel and Admiral Smyth in England, and by W. Struve and Argelander on the continent. The relation between the magnitudes of these different systems is indicated in the following:

| Herschel. | | Smyth. | | Struve. | | Argelander. |
|---|---|---|---|---|---|---|
| 6·4 | = | 6 | = | 5·7 | = | 5·9 |
| 7·0 | = | 6·5 | = | 6·3 | = | 6·4 |
| 7·4 | = | 7 | = | 6·5 | = | 6·8 |
| 7·8 | = | 7·5 | = | 6·9 | = | 7·5 |
| 8·2 | = | 8 | = | 7·4 | = | 8·0 |
| 8·8 | = | 8·5 | = | 7·9 | = | 8·6 |
| 9·5 | = | 9 | = | 8·3 | = | 9·0 |
| 10·1 | = | 9·5 | = | 8·9 | = | 9·4 |
| 10·4 | = | 10 | = | 9·3 | = | 9·4 |
| 11·3 | = | 11 | = | 10·0 | = | 10·0 |
| 11·7 | = | 12 | = | 10·4 | = | 10·6 |
| 12·5 | = | 13 | = | 10·7 | = | 11·2 |
| 13·3 | = | 14 | = | 10·9 | = | 11·8 |
| 14·5 | = | 15 | = | 10·9 | = | 12·4 |
| 15·9 | = | 16 | = | 10·9 | = | 13·0 |

It will be perceived that while the systems of Sir J. Herschel and Smyth are nearly enough alike to be practically interchangeable, the systems of Struve and Argelander are unlike for the fainter orders, and both differ markedly from the English system of indicating magnitudes. Unfortunately no system has been adopted uniformly by astronomers, or even by the astronomers of any given nation. Perhaps Argelander's is on the whole the best. Herschel's and Smyth's systems err in requiring that nicer distinctions should be drawn among very faint stars than ordinary observers can be expected to recognize. Struve's system appears to err in the opposite direction, by allowing too many stars to be included in the different orders of very faint stars.—The word "magnitude" as used in connection with stars refers only to apparent brightness; for the true magnitudes or volumes of stars are unknown. To determine a star's real magnitude, its distance must be determined and also its apparent diameter. But it is only in a few instances that the annual parallax of a star has been determined; and not a single star, however highly magnified, shows a true disk. Hence it is impossible to determine the volume of any star. In the few cases where the distance has been determined, it becomes possible to infer from the star's apparent brightness the total quantity of light emitted by it; and if we assume that equal portions of the star's surface and of our sun's emit equal amounts of light, we can compare the surface of such a star with our sun's surface, and so deduce its diameter and volume; but the assumption is not by any means safe. Very few stars have a measurable annual parallax. The following table includes all hitherto dealt with:

| STARS. | Magnitude. | Parallax. | Latest measures. |
|---|---|---|---|
| α Centauri | 1 | 0·976″ | 0·91″ |
| 61 Cygni | 6 | 0·348 | 0·55 |
| Lalande, 21258 | 8 | ..... | 0·26 |
| Oeltzen, 17415–6 | 9 | ..... | 0·25 |
| α Lyræ | 1 | ..... | 0·16 |
| Sirius | 1 | 0·150 | 0·27 |
| 70 Ophiuchi | 5 | ..... | 0·16 |
| 1 Ursæ Majoris | 3 | ..... | 0·13 |
| Arcturus | 1 | ..... | 0·13 |
| Polaris | 2 | 0·067 | 0·11 |
| Capella | 1 | ..... | 0·05 |
| Procyon | 1 | ..... | 0·12 |

Of the above measures, we owe the earliest, that of 61 Cygni, to Bessel; but it will be perceived that later measures differ appreciably from his. Henderson gave the earliest measures of α Centauri and Sirius, the corrected estimate for Sirius having been obtained by Mr. Cleveland Abbe, formerly of the observatory of Pulkova, now of Washington; most of the remaining measures are due to the labors of Krüger and Peters. When we observe that only α Centauri has given consistent results, we may well doubt whether as yet astronomers possess instruments competent to measure small parts of a second of arc. The distance of this star corresponds to the space traversed by light in about 3½ years, the distances of the other stars being greater according as the parallax is less; so that, for instance, if the parallax of Capella in the above list were strictly exact, Capella would be 19½ times further away than α Centauri, and light would not reach us from it in less than 63½ years. It would be a fair inference that the light of

many telescopic stars reaches us now only after the lapse of many thousands of years. To apply to $\alpha$ Centauri the method for inferring a star's volume, indicated above, we proceed as follows: The star's distance exceeds the sun's 230,000 times, so that the sun removed to that star's distance would shine with only $\frac{1}{52,900,000,000}$ part of his observed lustre. But it has been found by Zöllner that $\alpha$ Centauri shines with about $\frac{1}{16,950,000,000}$ part of the sun's brightness. Hence the star emits three times as much light as the sun, or (if our assumption as to equal intrinsic surface brightness be correct) $\alpha$ Centauri has a surface three times, a diameter $\sqrt{3}$ times, and a volume $3\sqrt{3}$ times (*i. e.*, more than five times) greater than the sun's. If we dealt with Sirius in like manner, we should deduce a volume exceeding the sun's about 2,700 times (taking the mean of the values above given for his annual parallax). But there is reason to believe that the real volume of Sirius, though far exceeding the sun's, is much less than that we have thus deduced; whence it is to be inferred that the larger stars shine with a greater intrinsic lustre than our sun, or in other words that a square mile of the surface of a large star like Sirius gives out much more light than a square mile of the sun's surface. It is not improbable that we may find hereafter in such considerations the means of distinguishing between the various orders of real star magnitudes, since stars of different intrinsic brightness might be expected to give different results under spectroscopic analysis. We have shown under SPECTRUM ANALYSIS that such differences unquestionably exist in stellar spectra; but as yet it has not been found possible to associate them satisfactorily with differences in the sizes of stars. In fact, when we observe that Capella, though a star not only of the leading order of apparent magnitude, but also, judging from its minute annual parallax, one of the largest in real volume, yet belongs to the second spectral class, that is, the class of stars resembling our sun, we can scarcely place much reliance on this method of discriminating large from small stars.—Closely connected with the question of the various orders of stars is the circumstance that many stars are colored. Of stars visible to the naked eye, only the brightest show recognizable color, at least as so viewed. Antares, Betelgeuse, and Aldebaran are ruddy; Arcturus, Pollux, and Procyon yellow; Vega and Altair bluish; Capella, Sirius, Canopus, and many others, brilliantly white. But among telescopic stars more marked instances of color occur, some stars being blood-red, garnet-colored, rich orange, golden yellow, and so on. It is noteworthy that few single stars show such colors as blue, green, violet, or indigo; but among double and multiple star systems not only are these colors recognized, but such colors as lilac, olive, gray, russet, and so on. A beautiful feature in many double stars remains to be noticed: it is often found that the components exhibit complementary colors. This is oftener seen among unequal doubles; and then the larger component shows a color from the red end of the spectrum, as red, orange, or yellow, while the smaller shows the corresponding color from the blue end, as green, blue, or purple. The colors are real, not merely the effect of contrast, for when the larger star is concealed the color of the smaller remains (in most cases) unchanged. Spectrum analysis shows that the colors of many double stars are due to absorptive vapors cutting off certain portions of the light.—The existence of double and multiple star systems is itself remarkable, and the theory of a real physical connection between the members of such systems was long opposed because of the strangeness of a conception which in our own day has become familiar to us. Of course, many stars apparently double are in reality far apart, and merely brought into accidental association because both lie nearly on the same visual line. But not only is the number of such pairs far greater than it should be to be thus explained, but also many pairs have been watched during long periods, and it has been found that the components are circling around each other, or rather around their common centre of gravity. Among the most remarkable instances of this kind are the double star 70 Ophiuchi, which completes a revolution in about 80 years; the stars of the pair $\xi$ Ursæ Majoris, which complete the circuit around their common centre of gravity in about 60 years; Castor, $\gamma$ Virginis, $\xi$ Boötis, $\zeta$ Cancri, and other doubles, which exhibit equally noteworthy motions. Many catalogues of double stars have been formed by astronomers since Sir W. Herschel first paid special attention to the work. He observed 2,400; W. Struve of Dorpat observed 3,063; Dembowski, Secchi, Webb, and others in Europe have observed many double stars, carefully measuring the distance between the components, the angle of position, color, and so on, thus forming a fund of materials from which future astronomers can determine what changes are taking place in these interesting systems. Among such catalogues, those recently formed by Mr. Burnham of Chicago will hold a distinguished place because of the "difficulty" of the double stars he has observed, arising chiefly from the nearness of the components, or from the smallness of one or both. It is remarkable that though every region of the heavens contains double stars, they are more abundant by far in some regions than in others; while again some regions of the heavens contain double stars of particular orders only or chiefly. This leads us to notice the circumstance that aggregations of stars of greater and greater extent are recognized as we extend our survey of the heavens. Of all such aggregations the most complex is the galaxy or milky way (see GALAXY), in which millions of stars shine with lustre so blended and softened by

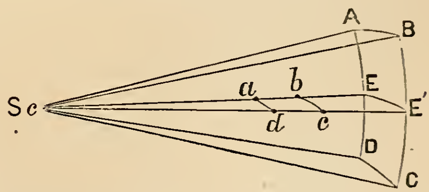
distance as to present a milky luminosity.—Many stars are variable in brilliancy. These may be divided into periodic variables, irregular variables, and temporary stars. Periodic variable stars are those which undergo increase and diminution of light at regular intervals. Thus the star Mira or *o* Ceti varies in lustre, in a period of 331⅓ days, from the second magnitude to a faintness such that the star can only be seen with a powerful telescope, and thence to the second magnitude again. It shines for about a fortnight as a star of the second magnitude, and then remains invisible for five months, the decrease of lustre occupying about three months, the increase about seven weeks. "Such," says Sir J. Herschel, "is the general course of its phases. It does not always, however, return to the same degree of brightness, nor increase and diminish by the same gradations; neither are the successive intervals of its maxima equal. From recent observations and inquiries into its history by Argelander, the mean period would appear to be subject to a cyclical fluctuation, embracing 88 such periods, and having the effect of gradually lengthening and shortening alternately those intervals to the extent of 25 days one way and the other. The irregularities in the degree of brightness attained at the maximum are probably also periodical." These irregularities are considerable. Thus between October, 1672, and December, 1676, Mira was never visible to the naked eye, while on Oct. 5, 1839, it was half a magnitude above its usual brightness, outshining *α* Ceti and *β* Aurigæ, which usually are brighter than Mira at its maximum. It suggests a probable explanation of these changes of brightness, that when the star is near its minimum its color changes from white to a full red, which, from what we know of the spectra of colored stars (see Spectrum Analysis), seems to indicate that the loss of brightness is due to the formation of many spots over the surface of this distant sun. Algol (or the Demon) is another remarkable variable, passing however much more rapidly through all its changes. It is ordinarily a second magnitude star, but during about seven hours in each period of 69 hours its lustre first diminishes until the star is reduced to the fourth magnitude, and after it has remained 20 minutes at its minimum, its lustre is gradually restored. Thus Algol remains a second magnitude star for about 62 hours in each period of 69 hours. These changes seem to correspond to what might be expected if a large opaque orb is circling around this distant sun in a period of 69 hours, transiting its disk at regular intervals. The star *β* Lyræ has a full period of 12d. 22h., divided into two periods of 6d. 11h., in each of which the star has a maximum brightness of about the 3½ magnitude, but in one period the minimum is about the 4½ magnitude, while in the other it is about the 4½ magnitude. This peculiarity points to an opaque orb with a satellite, the satellite being occulted by the primary in the alternate transits, and therefore the total loss of light less. The star *δ* Cephei varies in a period of 5d. 8h. 48m. from the fifth to the 3·5 magnitude, taking 1d. 14h. in passing from minimum to maximum of brightness, while it occupies 3d. 19h. in passing from maximum to minimum. Two or three hundred variable stars are already known. Among irregular variables the most remarkable is the star *η* Argûs. In 1677 Halley catalogued it as of the fourth magnitude; in 1751 Lacaille estimated it as of the second. Between 1811 and 1815 the star was of the fourth magnitude, and from 1822 to 1826 of the second; on Feb. 1, 1827, it had increased to the first magnitude; it fell again to the second magnitude, and remained so till 1837; in 1838 it increased in brightness, till it nearly equalled *α* Centauri; and it diminished again till 1843, when, however, it was still of the first magnitude. In April, 1843, it rapidly increased "until it nearly equalled Sirius in splendor." At present it is barely visible to the naked eye, and though it has lately been slightly increasing in brightness, it is still only of the sixth magnitude. The star *α* Orionis is another remarkably irregular variable, but amid all its changes it never descends below the first magnitude.—Temporary stars include the so-called new stars, as well as those which were formerly recorded in the catalogues of astronomers, but can no longer be seen, or have at least so changed in brightness as not to be recognized. The most remarkable instance of a new star is that which appeared in 1572 and was observed by Tycho Brahe. "It suddenly shone forth in the constellation Cassiopeia with a splendor exceeding that of stars of the first magnitude, or even Jupiter and Venus at their brightest, and could be seen with the naked eye on the meridian in full day. Its brilliancy gradually diminished from the time of its first appearance, and at the end of 16 months it entirely disappeared, and has never been seen since. During the whole time of its apparition, its place in the heavens remained unaltered, and it had no annual parallax; so that its distance was of the same order as that of the fixed stars. Its color, however, underwent considerable variations. Tycho described it as having been at first of a bright white; afterward of a reddish yellow, like Mars or Aldebaran; and lastly of a leaden white, like Saturn." A somewhat similar instance occurred in 1604, when a first magnitude star suddenly appeared in the right foot of Ophiuchus. It presented appearances resembling those shown by the former, and disappeared after a few months. In 1866 a star appeared in the Northern Crown, the observations of which threw great light on the subject of so-called new stars. In the first place, it was found that where this new star appeared there had been a tenth magnitude star; the new star then was in reality a star

long known which had suddenly acquired new brilliancy. When first observed by astronomers with this abnormal lustre it was shining as a star of the second magnitude. Examined by Huggins and Miller with the spectroscope, its light revealed a startling state of things in those remote depths of space. The usual stellar spectrum, rainbow-tinted and crossed by dark lines, was seen to be crossed also by four exceedingly bright lines, the spectrum of glowing hydrogen. Either the star was actually "in flames" at the time, that is, surrounded by burning hydrogen, or else some cause had raised the hydrogen around the star to a state of intense heat, but without actual combustion. The greater part of the star's light manifestly came from this glowing hydrogen, though it can scarcely be doubted that the rest of the spectrum was brighter than before the outburst, the materials of the star being raised to an intense heat. The maximum brightness of the star exceeded that of a tenth magnitude star nearly 800 times. After shining for a short time as a second magnitude star, T Coronæ (as the star was called thenceforth) diminished rapidly in lustre, and it is now between the ninth and tenth magnitudes.—The stars are not absolutely at rest, though many years pass before the motion of any star can be detected. Halley, comparing the observed places of Arcturus, Aldebaran, and Sirius with the places assigned by the Alexandrian astronomers, found reason to believe that these three stars are approaching the ecliptic. This surmise was confirmed by the elder Cassini, who observed that Arcturus had shifted southward 5′ in latitude since the time of Tycho Brahe. Bradley made observations to give means for detecting stellar motions, and before long astronomers began to recognize many instances of measurable motion. In 1783 Sir W. Herschel took up the idea that the stellar motions are in part due to a proper motion of the sun himself. Tobias Mayer had suggested this idea in 1771, but comparing Römer's observations with his own could find no evidence in its favor. Herschel was more successful. From the motions of seven stars, as estimated by Maskelyne, he deduced the inference that the sun is moving toward a point in the constellation Hercules in right ascension 257°. From a more exact inquiry, using Mayer's list of proper motions, he was led to place the point toward which the sun is moving (or, as it is called, the "apex of the solar way") near the star Herculis. In 1805, using Maskelyne's catalogue of the proper motions of 36 stars (published in 1790), he set the apex in right ascension 245° 52′ 30″ and N. declination 49° 38′. Bessel in 1818 expressed his agreement with Tobias Mayer, in regarding the evidence as insufficient for determining the direction of the sun's motion; but since then Mädler, Argelander, O. Struve, and Sir G. B. Airy have dealt with the problem, with results confirming the views of Sir W. Herschel in a very remarkable way, considering the imperfect evidence available in Herschel's time. Nevertheless it is noteworthy that, although the balance of the stellar motions indicates the real existence of a proper motion of our sun toward Hercules, yet on any of the usually accepted theories of stellar distribution, the stellar motions accounted for by the sun's motion do not form nearly so large a proportion of the observed stellar motions as they should do. The present writer has shown by a simple geometrical method that they should constitute one half of the total; or rather, that the sum of the squares of the observed displacements should be reduced one half on making the proper correction for the effects due to the sun's motion. The real reduction, instead of being one half, is between $\frac{1}{25}$ and $\frac{1}{26}$. This does not throw any doubt on the fact of the sun's motion, but it renders altogether untenable the commonly accepted theories as to stellar distribution.—The motions hitherto mentioned are apparent motions of the stars on the celestial sphere. Motions of recession or of approach would of course not be indicated in this way; nor would they produce any appreciable change in a star's brightness. This is easily perceived when we consider that motions of recession or of approach would be of the same average order as thwart motions. What thwart motions may be in actual amount we do not know, but we do know what proportion they bear to the distances of the stars they respectively appertain to. Thus if a star were displaced 10″ in a year (and no star has yet been observed to have so large a proper motion), the actual distance traversed in one year would be to the star's distance as sin. 10″ to 1, or as 20,626 to 1. A corresponding motion of recession or approach would therefore diminish or increase a star's brightness in one year by $\frac{1}{10323}$ part, and the brightness would be diminished or increased only by $\frac{1}{100}$ part in 103 years. Such a change would be quite inappreciable even if the observation of irregular variations of stellar brightness did not prevent us from placing any reliance on apparent changes of brightness as indications of distance. It might then appear hopeless to attempt to determine whether the stars have motions of recession or approach; but spectroscopic analysis affords a means of dealing with this problem which has been successfully applied by Huggins and Vogel, and may hereafter be widely extended. If a star is changing its distance from us, light waves of any given order proceeding from the star must reach the observer with their length increased if the star is receding, and decreased if the star is approaching. On comparing, then, any known line in a stellar spectrum with the corresponding line in the spectrum of the terrestrial element, any shift of the line which can be detected will indicate recession if toward the red end of the spectrum, and approach if toward the indigo end. Applying this method, Huggins has recognized motions

of recession and approach ranging from 10 m. to nearly 50 m. a second.—Some of the stars have proper motions in the same direction and at the same apparent rate. Mädler, noticing this peculiarity in the constellation Taurus, was led to surmise that the centre round which all the stars are moving lies in that constellation, and he assigned Alcyone, the principal star of the Pleiades, as the centre in question. Beyond the observed community of motion in Taurus there was not any direct evidence for this theory; and this observed phenomenon was held by astronomers to afford but weak evidence for a theory of importance. Yet Mädler's views were described in every text book of astronomy, in terms which would have been scarcely justified if there had been an overwhelming mass of evidence in their favor, and if astronomers had been practically unanimous in accepting them. In point of fact, even the one piece of direct evidence which seemed to support Mädler's theory is found on examination to have no weight whatever. It is true that if there is a centre around which all the stars are moving, the stars lying toward that centre should exhibit a community of proper motions, and the stars in Taurus do exhibit the peculiarity; but unfortunately for the theory, the same feature exists in other parts of the heavens. A map constructed by the present writer, showing all the stellar proper motions as yet satisfactorily determined, exhibits many such cases, and some of them are more remarkable than the case of the stars in Taurus. One singular instance of this "star drift" is observed in the constellation Ursa Major, in which the stars $\beta$, $\gamma$, $\delta$, $\varepsilon$, and $\zeta$ are all travelling in the same direction and at the same rate. As these are bright stars, it appeared to the writer that they would afford an instructive test of the theory of star drift, if their motions of recession or approach could be determined. This was effected by Huggins a year after the theory of star drift had been enunciated, and it was found that, as the theory required, the five stars had a common motion in the direction of the line of sight, and that they are all receding at the rate of about 17 m. a second from the solar system. The inference fairly deducible from this fact, that these stars form a single system or family travelling together through space, is interestingly confirmed by the fact that all five belong to the same order. (See Spectrum Analysis.)—Although many speculations were broached respecting the constitution of the sidereal heavens from the earliest ages of astronomy, the first to enter on the systematic study of the subject, combining observation with theory, was Sir W. Herschel. Mitchel, it is true, had theorized carefully and soundly, but his labors were not extended beyond a few points of detail; and though Wright of Durham made some observations for the purpose of determining the structure of the milky way, yet the telescope he used (only one foot in focal length) was far too small to give any really satisfactory results. At the beginning of his labors Sir W. Herschel took as the basis of his conceptions the belief that our sun is a member of a system of suns, scattered with a certain general uniformity throughout a region of space having a defined figure, possibly determinable if only a telescope could be constructed powerful enough to reach the limits of the system in all directions. To effect this, he devised his system of "star gauging by counting." It is clear that the further the sidereal system extends in any given direction, the greater will be the number of stars lying toward that direction, since the distribution is supposed (in a general sense) uniform; and therefore, if the same telescope, with unchanged power, were directed toward every part of the heavens in turn, then by counting the number of stars brought into view in these different directions the relative extension of the system along those visual lines could be determined—in other words, the shape of the star system. Let it be noticed that this plan of star gauging required that one and the same telescope should be applied to different parts of the heavens; it assumed a general uniformity of distribution within the limits of the system; and it required that the telescope should penetrate to those limits. Recognizing these points, we shall not fall into the mistake made by many (including Arago and the French astronomers generally, Smyth, and others, and repeated in almost all the text books) of confounding this method of star gauging with the method devised by Sir W. Herschel when a long experience had convinced him that the assumptions on which he had based the former method were unsound. While he still supposed these assumptions sound, however, he deduced as the result of applying his first method the inference that the sidereal system is shaped like a cloven flat disk. (See Galaxy.) But gradually his observations showed him that special laws of aggregation exist within the star depths. He saw, first, that the milky way is not produced by the combined lustre of stars scattered like those around us, but extending to enormous distances. Next he perceived that the stars forming the richer parts of the milky way are not arrayed along great ranges in distance, but really spread more richly within limited and roughly globular regions. In the same paper (all the passages we quote are from the "Philosophical Transactions") he wrote as follows: "On a very slight examination it will appear that this immense starry aggregation [the milky way] is by no means uniform. . . . By referring to some one of these clustering aggregations in the heavens, what will be said of them will be much better understood than if we were to treat of them in a general way." He selects the great double clustering aggregations in Cygnus, which form such conspicuous star clouds on clear summer nights. Here, he says, "the stars are clustering with a kind of

division between them, so that we may suppose them to be clustering toward two different regions. By a computation founded on observations which ascertain the number of stars in different fields of view, it appears that our space [*i. e.*, our selected region] in Cygnus, taking an average breadth of about five degrees of it, contains more than 331,000 stars; and admitting them to be clustering two different ways, we have 165,000 stars for each clustering collection. Now the above mentioned milky appearances deserve the name of clustering collections, as they are certainly much brighter about the middle, and fainter near their undefined borders. . . . We may indeed partly ascribe the increase both of brightness and of apparent compression to a greater depth of the space which contains the stars, but this will equally tend to show their clustering condition; for since the increase of brightness is gradual, the space containing the clustering stars must tend to a spherical form if the gradual increase of brightness is to be explained by the situation of the stars." That is to say, whether we consider the greater richness in the centre to be due to the clustering of stars toward the middle of these aggregations, or to the shape of the groups themselves, or partly take both causes of central richness into account, we are alike led to the conclusion that the groups are roughly spherical in shape. This conclusion, it need hardly be said, is utterly opposed to Herschel's old belief in a star system generally uniform throughout its whole extent; for here, and in all similar cases, we see rounded clouds of stars as distinct from the stars scattered around us as rounded clouds in the sky are distinct from a thin low-lying fog through which their shapes are seen. Accordingly, before long Sir W. Herschel saw the necessity of devising a new method of star gauging, based, not on the numerical richness of star fields, but on the telescopic power necessary to effect the resolution of the milky light of clustering aggregations into discrete stars. By this process he hoped to determine the relative distances of star groups. Supposing that a particular aggregation began to be resolved into discrete stars with a certain telescopic power, and was entirely resolved when a certain higher power was employed, there would be *prima facie* evidence as to the distance of the aggregation, if the stars forming different aggregations are similarly distributed. For, given a group of stars of certain sizes and set at certain distances from each other, it is clear that the further away the group is placed, the higher will be the telescopic powers required (1) to begin and (2) to complete the resolution of that group into separate stars. How perfectly unlike this method was, at once in principle and in practical details, to the former, will be seen from a comparison of the earlier method, above, with the following summary of the qualities of the later method. In the new method, the same part of the heavens was to be examined successively with different telescopes; the observer was not to count stars, but to note the extent to which resolution was effected; it was assumed that the stars within the clustering aggregations were distributed far more richly than elsewhere; and the telescope was required to effect resolution within a particular region of space, not to merely extend vision to particular distances. It is manifest that the new method and the assumptions on which it is based are open to exception. Herschel had found that the stars are not spread uniformly through the star system, as he had before surmised; and one would have supposed that having thus been misled by one assumption, he could not adopt others differing from it in degree only, not in kind. Yet his second method of star gauging could only give him, as he hoped, the means of "ascertaining a scale whereby the extent of the universe, so far as it is possible for us to penetrate into space, may be fathomed," if, first, the stars were spread uniformly within each clustering aggregation, and secondly, if different clustering aggregations were similarly constituted. For clearly, if one and the same aggregation included several orders of stars, each order distributed with a degree of richness peculiar to itself, and still more if there were not even any law of distribution for the several orders, then no reliance could be placed on the method; for a telescope might effect resolution with respect to some particular order of stars within the aggregation which would leave orders of smaller or more closely set stars within it quite unresolved. Nor again could any comparison be instituted between the distances of two aggregations resolved by particular telescopes, even though there were reason to believe that within each there was a general uniformity of distribution, unless we were certain that they were alike in constitution. If the more remote of two aggregations consisted of large stars sparsely strewn, and the nearer consisted of small stars closely set, the two aggregations might require exactly the same power for their resolution, notwithstanding the difference of distance. On the latter point Herschel's observations by the new method could throw little light, since there is no telescopic means of discriminating really large from really small stars. But on the former point he obtained evidence which should have been decisive against the new method of gauging, or rather against the assumptions on which it was based. For he observed several clusters which began to be resolved with very low telescopic powers, but were not entirely resolved even with the largest telescopes and highest powers Herschel employed. As these clusters were of small extent and round in figure, it followed that if the stars were spread uniformly within them, the extension of these clusters in the direction of the line of sight must enormously exceed their thwart diameter; in other words, that they

were all of them shaped like gigantic cylinders, of length vastly exceeding their breadth. This supposition being altogether untenable, it is certain that these clustering aggregations contain stars of many orders of real magnitude, distributed according to various laws of richness. . In fact the range of magnitude and of richness of distribution must be as great as in the case of the solar system, from the giant bulk of Jupiter and Saturn to the minute and (relatively) closely aggregated asteroids. And here in passing we may note that this legitimate inference from the observations of Sir W. Herschel is abundantly confirmed by Sir John Herschel's examination of the Magellanic clouds, in which all varieties of stellar magnitude and aggregation, from sparsely strewn stars of the eighth and ninth magnitudes to a nebulosity irresolvable by his 18-inch mirror (besides all orders of nebulæ), coexist within limits of distance not differing in proportion more than as 10 to 9. According to the assumptions on which Sir W. Herschel's second method of star gauging was based, the limits of distance to include such varieties of stellar distribution should differ in proportion more than as 300 to 1. Passing over the work of Sir J. Herschel, who, so far as stellar distribution is concerned, contented himself by extending his father's first method of star gauging to the southern heavens, we come to the work of W. Struve, whose researches are distinguished by a further extension of the theory of non-uniformity in stellar distribution. He, first of all astronomers since Herschel's papers were written, perceived their real purport, and the incorrectness of the description given by Arago, at least partially. He does not seem to have sufficiently weighed the significance of Herschel's remarks respecting the rounded figures of many clustering aggregations, and he quite misunderstood Herschel's observation that "when he could not resolve rich stellar regions, it was because they were unfathomable." (He appears to have read the word "when," in this sentence, as equivalent to the German *wenn*, since it is rendered by *si* in Struve's *Études d'astronomic stellaire.*) But he clearly perceived that Herschel had given up as early as 1802, if not earlier, the theory of a general uniformity of stellar distribution. Having found, indeed, that the stars down to the eighth magnitude are more richly spread over the milky way than elsewhere (whereas if stars were uniformly distributed within the system, these brighter orders, lying all far within even the nearer limits of the galaxy, should appear uniformly distributed over the heavens), he at first supposed that he had obtained a result opposed to the views of Sir W. Herschel; but having re-examined the whole series of Herschel's papers, he found that the result was quite accordant with Herschel's later views, and opposed only to views which Herschel had abandoned early in his career as an observer. But now Struve, having thus obtained evidence of a want of uniformity in the distribution of the stars, and having found that Sir W. Herschel had recognized an even wider range of irregularity, nevertheless proceeded (as Herschel had done, but in other directions) to assume laws of uniformity which, to say the least, should have been demonstrated before they were adopted as the basis of stellar theories. He assumed that stars gather more richly toward the medial plane of the galaxy, but that at equal distances from that plane the distribution is equally rich (on the average for that distance), and that stars in different regions have equal average dimensions. He counted all the stars down to the ninth magnitude in each hour of right ascension between 15° N. and 15° S. of the equator (or rather he took the numbers from Weisse's catalogue), and supposed them gathered on the equator, toward each "hour" of the equator its proper number, spread uniformly. Then he supposed the equatorial ring of stars thus formed spread over an equatorial disk, in horary sectors, and uniformly over each segment of such sectors limited by radii corresponding to star magnitudes. Thus, suppose E E′ to be a horary arc of the equator, and therefore 15° in length, A E D, B E′ C parts of hour circles, A B, D C parts of parallels having 15° N. and S. declination, S the sun; and let S *b*, S *c* represent




resent the greater limit, and S *a*, S *d* the lesser limit of stars of the seventh magnitude. Then Struve, having counted the stars of all magnitudes down to the ninth in the space A B C D, conceived them first distributed uniformly along the equatorial arc EE′, and next spread them over the sectorial area S E E′, distributing all of the seventh magnitude uniformly over the plane surface *a b c d*. Thus he obtained his equatorial section of the galaxy; and he persuaded himself that this artificial method of distributing the stars was based entirely upon observation, without any arbitrary hypothesis whatever. Prof. Forbes said justly, speaking of Struve's method: "I am persuaded that the popular writers and reviewers who have given additional publicity to the most striking and positive of M. Struve's conclusions, have (very naturally) done so on the strength of the author's well deserved reputation as an observer, and without attempting to analyze his reasoning, which it must be owned is sometimes obscure. My objections," he proceeds, "to M. Struve's argument were put in writing several years ago (1850), but not published except in my lectures. It was only in 1855 that I saw for the first time a memoir by Prof. Encke in the

*Astronomische Nachrichten*, vol. xxvi., No. 622 (published in 1848), maintaining the same view of the invalidity of M. Struve's reasoning, and questioning the hypotheses (of which M. Encke reckons five) tacitly assumed by him." The present writer, led independently to the same general views respecting Herschel's labors which Struve had formed, and afterward to the same general views respecting Struve's labors which Forbes and Encke formed, adopted the following as the principle on which fresh researches should be based: That as regards the laws of stellar distribution, the range of stellar magnitude, intrinsic brilliancy, and so on, we must assume nothing, all assumptions having been proved by the clearest possible evidence to be untrustworthy. We must be guided by the facts alone. Nor are we thus compelled to abandon as hopeless the great problem of the star depths. Even where Herschel's methods seemed to fail, they afford excellent promise of success. His first method, for example, had to be abandoned, so far as his original purpose was concerned, because he found reason to believe that the great rich regions of the milky way are situated like mighty clouds of stars in space, and are not mere ranges of stars extending continuously from our own neighborhood. But it was the method itself which taught this, which in fact effected this capital discovery. The second method, again, cannot be interpreted as Herschel hoped; it cannot tell us how far off, relatively, are different star groups. But this application of the method has to be abandoned simply because the use of the method itself has taught us that the architecture of the heavens is far too complex to be interpreted in so simple a manner. Here then is another great discovery effected by a method of star gauging which, so far as its original purpose was concerned, has had to be rejected. But so soon as we recognize these facts, a method of research is suggested which combines the trustworthy qualities of both methods, and is free from the faults of either. We must employ Herschel's first method of star gauging, counting the stars in equal fields with the same telescope; but we must not limit ourselves to the study of a star field here and there. The whole heavens must be surveyed, and this not with one telescopic power only, but with many, from the lowest powers to the highest available. The results obtained with each power must be compared together, after being carefully indicated in suitable charts; a method altogether more satisfactory than any processes of statistical enumeration. Differential charts, showing by how much each increase of power increases in each region the number of stars brought into view, ought also to be constructed. No preconceived opinions should be suffered to mar the teachings thus obtained; but the architecture of the heavens must be viewed precisely as it is presented to us by these results. Principles of interpretation, however, may legitimately be applied to the evidence, so long as they are founded on just considerations. It appears to the writer that the following principles are not open to question in this respect: 1. Where two surveys made with different telescopic powers indicate concordant laws of distribution over the heavens, the rich regions thus indicated are regions where the orders of objects dealt with by the two telescopes are intermingled. 2. Where instead of such accordance a law of contrast is indicated, regions rich in one order of objects being poor in another and *vice versa*, the two orders still belong to one system, but some peculiarity in the laws according to which they were formed causes them to occupy different parts of the system, segregating as it were from each other. 3. Where no connection whatever either of agreement or contrast can be recognized, it is probable, and in general presumable, that the two orders are altogether distinct and lie at different distances from each other. 4. Where partial or local agreement or contrast is indicated, the inference is that the true arrangement of the objects in space is affected both by laws of aggregation or segregation and by diversities of distance, and by one cause or the other to a degree corresponding to the extent of such agreement or contrast. What is here said of objects brought into view by different telescopic powers is true of different orders of objects, as nebulæ, double stars, colored stars, variables, and so on. These principles have been applied by the writer already to stars visible to the naked eye in both hemispheres, to stars down to the tenth magnitude of Argelander in the northern hemisphere only, and to the known nebulæ (5,500 in number) in both hemispheres. As an illustration of the fertility of the process, the following results may be indicated: First, the stars visible to the naked eye are not distributed uniformly through surrounding space, but are gathered markedly in two rich regions, one northern, the other (larger) southern, and are particularly rich in the region of the milky way; but the leading orders of these stars are gathered zonewise in a region somewhat inclined to the milky way; a circumstance first noted by Sir J. Herschel, but independently by the present writer and also by Prof. B. A. Gould. The northern stars, down to the tenth magnitude inclusive, are gathered in the most marked manner in the galactic zone, not increasing gradually in richness of distribution as they approach it, but being gathered richly in the nodules, clustering aggregations, streams, and whorls of stars of which the galaxy consists. This circumstance proves that the milky way is not only apparently but really so formed; and since Herschel's gauges show that wherever the milky way appears bright to the naked eye, there the fainter orders of stars, down to the least brought into view by his great telescope, are most richly strewn, it follows that these fainter

orders and the brighter stars of the first ten magnitudes are really intermingled in space, whence the fainter must be very much smaller than the brighter in these regions; though of course this does not prevent us from believing that a certain proportion of the fainter stars are really far more remote than the brighter stars. The nebulæ are found to be strewn in such a way that the second of the above laws is directly applicable to the relation between them and the fixed stars. For along the zone of the milky way few nebulæ are found, and those belonging only to two orders, the irregular (gaseous) nebulæ and star clusters. The further we proceed from the galactic zone, the more richly do we find the nebulæ scattered. This relation was first noticed by Sir W. Herschel, but not thoroughly established until Sir J. Herschel had completed the survey of the southern heavens. Mr. Cleveland Abbe made a more exact analysis, in which he dealt with all the nebulæ in Sir J. Herschel's latest list, classifying them according to their resolvability, and showing that the density of nebular distribution increased with the distance from the galactic zone for the irresolvable nebulæ, but diminished with that distance for the clusters. These researches were statistical. The present writer has employed Mr. Abbe's tables in the construction of an equal surface chart of the nebulæ, showing the law of their distribution to the eye. It is thus seen that there is not a gradual condensation of nebulæ toward two opposite regions, near the poles of the galactic zone, but that the nebulæ are gathered into streams, nodules, and irregular aggregations such as we find in the grouping of stars. We have said that law 2 characterizes the relation between stars and nebulæ; in other words, that their arrangement follows the law of contrast. There are two remarkable exceptions to this law, the Magellanic clouds. In these, where stars of all orders, from the ninth magnitude to irresolvable stellar aggregations, are as richly gathered as on the galactic zone, nebulæ of all orders are also gathered richly, even more so than anywhere else over the whole heavens.—It will be evident from what has here been shown, that the sidereal system is not the simple scheme imagined by the earlier astronomers and still described in most of the text books of astronomy. No law of uniformity of distribution can now be accepted, for one law after another has been disproved by the clearest possible evidence. Accidental numerical correspondences, found in the distribution of stars of various orders spread over large regions, cannot be admitted as evidence of uniform distribution of stars throughout surrounding space, or of any law of uniform condensation, when we find on analysis that these relations have to be otherwise interpreted. We know, for example, that the excess of stars of the fainter orders is not brought about by the mere extension of telescopic range, as Struve and Littrow have surmised, but has to be partly explained by the actually observed gathering of such stars in certain streams, clouds, sprays, and nodules of milky light. We must not allow any statistical rules (arbitrarily laid down in the first instance) to blind us to the facts thus disclosed. The future study of the sidereal system must in fine be based more exclusively on observation than heretofore; though even more laborious processes of deductive reasoning must be applied, since this, like all the greater problems of science, lies far beyond the range of mere induction. (See p. 891.)

**STARCH** (also called amylaceous matter and fecula), a proximate vegetable principle existing at certain periods of vegetable life in every plant that has been examined for it. It occurs especially in the seeds of cereals and other plants, in the tubers of potatoes, in tap roots, such as carrots and parsnips, in the pith of stems, as the sago palm, and sometimes in the bark. It is white, glistening, and pulverulent, composed of microscopic spheroids or granules of a firm consistency, varying according to their origin from $\frac{1}{200}$ to $\frac{1}{3000}$ of an inch in diameter, and contained in the cells of the cellular tissue of the plant, several being enclosed in one cell. (See fig. 1.) According to Payen, starch is found only when the nutriment is in excess, being consumed at the later stage of the vegetative process, when the nutriment becomes deficient. The young granules are exceedingly small, spherical, and homogeneous; but in developing they become ovoid, lenticular, or polygonal. They have a characteristic

Fig. 1.—Bean Starch lying in Cellular Tissue, magnified 200 diameters.

Fig. 2.—Starch Granules of *tous les mois*, magnified 150 diameters.

form and structure, being composed of a series of layers presenting the appearance of concentric markings, which, in connection with the size, are characteristic of the plant to which they belong. Each granule is marked by a peculiar spot called the *hilum*, at which point it is attached to the cell wall in its early state. When viewed by polarized light, each granule is seen to be marked by a dark cross having its point of intersection at the hilum, as in fig. 2, representing the granules of *tous les mois*, a starch obtained from the tubers of the *canna edulis*, a plant belonging to the order *marantaceæ*, which includes also the *maranta arundinacea* or West India arrow root, fig. 3. When a plate of mica or selenite is interposed, to produce interference of light, the cross becomes gorgeously colored. (See Light, vol.

x., p. 448.) The size of the granules in each plant is not uniform, but there is an average which is generally not much departed from, although sometimes, as in the potato, the dif-

FIG. 3.—Starch Granules of *Maranta arundinacea*, or West India Arrowroot, magnified 200 diameters.

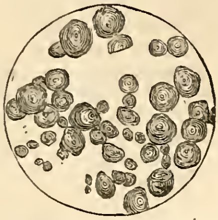


FIG. 4.—Starch Granules of *Manihot utilissima*, or Brazilian Arrowroot, magnified 225 diameters.

ference is great (see fig. 5), but then it is characteristic. It is now believed that each granule consists of two substances intimately mingled, which are alike in chemical composition, having the same proportion of elements as the cellulose ($C_6H_{10}O_5$) which forms the cellular structure of plants. These two substances are called granulose and cellulose, the former being soluble, the latter insoluble in boiling water. Starch is insoluble in cold water, and in alcohol and other liquids which do not decompose it; but when treated with about 20 parts of boiling water its granules swell, become gelatinous, and fuse into a thick opaline liquid; this on cooling solidifies into a homogeneous paste, or hydrated starch, which when dried becomes a hard horny substance like gum. If the starch is treated with 100 or 150 parts of boiling water, it forms an opaline liquid, which does not gelatinize, but on standing allows the cellulose constituent to form a turbid deposit, while the granulose, or soluble starch, remains in the transparent solution. Starch may be converted into dextrine and grape sugar by the action of diastase, or by boiling in a dilute acid. (See DEXTRINE, DIASTASE, and FERMENTATION.) It may be readily distinguished in the laboratory by the deep indigo-blue compound which it forms with iodine. The test is one of exceeding delicacy, but the iodine must be in a free state, for if it is combined with almost any other substance the affinity of the starch is not sufficient to abstract it. Starch may be obtained by rasping, bruising, or grinding the vegetable structure to pulp, and washing the mass upon a sieve, which retains the torn cellular tissue, or the gluten, while the starch passes through with the dissolved sugar and is precipitated, when it may be collected by decantation or elutriation, and washed and dried. The following table shows the percentage of starch in various kinds of food, according to Payen:

| | | | |
|---|---|---|---|
| Wheat | 57·88 | Potatoes | 20·00 |
| Rye | 64·65 | Sweet potatoes | 16·05 |
| Oats | 60·59 | Peas | 37·30 |
| Barley | 66·43 | Beans | 33·00 |
| Indian corn | 67·55 | Flaxseed | 23·40 |
| Rice | 88·65 | Cacao | 11·00 |

The size and appearance of the several different kinds of starch granules when examined by the microscope are given in the engravings. —Starch is extracted from grain by two principal processes, the old or fermenting, and the new or non-fermenting process. In employing the fermenting process the grain is steeped in water till it becomes soft enough to mash easily between the fingers. It is then passed through a malt mill or between rollers, and again mixed with water. Fermentation sets in, and lactic and acetic acids are formed, which disintegrate the cellular structure and liberate the starch granules. These are collected by repeated washings and precipitations, the process being continued for several days. The gluten undergoes putrefaction, emitting a most noisome odor. The sugar and a portion of the starch are converted into alcohol, and a part of this into lactic and acetic acids, which dissolve the gluten that has escaped putrefaction. Thorough washing and draining remove the soluble matters, and the starch left behind is next dried in blocks about 6 in. square; as the water escapes from them, the masses break up into the columnar fragments peculiar to starch. The other method, introduced by M. Émile Martin

FIG. 5.—Potato Starch, magnified 225 diameters.

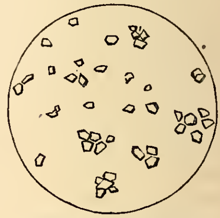


FIG. 6.—Rice Starch, magnified 300 diameters.

of Vervins, France, consists in kneading the flour into dough with water, and then washing on a sieve of No. 120 wire in a stream of water, as long as the water passes through milky. The starch in suspension and the sugary portion in solution are caught below the sieve, and the gluten nearly all remains behind in a sticky mass. What passes through is left to ferment 24 hours in an oven at 68° F., and a little leaven is added, or the skimmings of a former operation, to hasten the process. The portion of gluten carried through with the starch is thus separated and removed by skimming. The starch is then treated like that otherwise obtained. The product by this method is about 50 per cent. of the weight of the flour, while by the other process it is only from 35 to 40 per cent. Nearly the whole of the gluten also is saved in a condition suitable for food, either by mixing it with flour and making of it macaroni and similar pastes, or with boiled potatoes, and thus making a cheap and nutritious bread, by adding to the potatoes a nutritive element in which they are deficient. Potato starch is made from rasped or grated potatoes, by a process similar to that just described. This

variety does not assume the columnar form in drying, and is also peculiar in retaining a large amount of moisture, generally 20 per cent., or when saturated 23 per cent.—Rice is treated by a process patented in 1840 by Orlando

Fig. 7.—Wheat Starch, magnified 225 diameters.

Fig. 8.—Corn Starch, magnified 400 diameters.

Jones, which is also quite as applicable to the other grains. It is macerated in a weak alkaline solution, a gallon of water to every 2 lbs. of rice, and about 200 grains of caustic soda or potash to the gallon, which dissolves the gluten but leaves the starch. After standing about 24 hours, the alkaline liquid is drawn off, and the rice after being well washed is drained, and is then ground into flour. A fresh quantity of lye is added to it, and it is again digested for 24 hours, with frequent stirring. It is now left for 70 hours, in which time the dissolved gluten rises and is all found in a turbid, yellowish stratum at the top. This portion is carefully drawn off, leaving the fibrous portion of the grain at the bottom intermixed and covered with starch. The deposit is then stirred up and washed with abundance of cold water, and the mixture being left to repose, the fibrous portion is deposited with very little starch, and the remainder is drawn off by a siphon through a fine sieve into a cistern, when it is further washed and purified. The gluten is recovered by neutralizing its solution with sulphuric acid, by which means it is precipitated. The water is then drawn off and the gluten collected, dried, ground, and mixed with other flour. A patent was granted to James Colman of England in 1842 for making starch from maize and other grains by a process similar to that of Jones; but an application for a renewal of the patent of the latter in 1854 was refused because a similar one had been granted to Thomas Wickham in 1824. The manufacture of starch from Indian corn by an alkaline process was introduced in this country by Thomas Kingsford in 1842–'3, while foreman in the starch factory of William Colgate and co., in New Jersey. The two largest starch manufactories in the world are in the United States: one at Oswego, N. Y., established in 1848 by Thomas Kingsford and son, producing 21,500,000 lbs. annually; the other at Glen Cove, Long Island, established in 1858 by the Messrs. Duryea, and producing 19,000,000 lbs. annually. Their products, both laundry and edible corn starch, are largely sent to European and other foreign markets, and have taken the first prizes at international industrial exhibitions. Each establishment employs its own processes, and the recovery of the gluten is not practised, but this, with other parts of the grain separated from the starch, is sold as food for domestic animals.—The part taken by starch as a constituent of food is the most important of its numerous uses, being the principal element in the food of graminivorous and herbivorous animals, and an important one in that of man. It is used in the manufacture of dextrine or British gum, for stiffening linen and cotton goods, and for making size for paper and various other articles. It is employed in medicine for diluting and otherwise modifying the form of various articles of the materia medica; in surgery for preparing splints and bandages; and in the chemical laboratory for the detection of iodine.—Animal starch, called glycogen because it has the property of being transformed into glucose or starch sugar, exists in the livers of all healthy vertebrate animals, and in some of the tissues of other animals. It resembles vegetable starch, but yields a violet red instead of a violet blue color with iodine. (See Liver.)

**STAR CHAMBER, Court of the** (*curia cameræ stellatæ*, so called from the gilded stars on the ceiling of the old council chamber of the palace of Westminster, in which it sat), a tribunal famous in the political history of England, and mentioned as early as the reign of Edward III. It appears to have been then, and for upward of a century and a half afterward, identical with the ancient *concilium regis*, or king's ordinary council, which alone exercised jurisdiction, the *concilium secretum*, or privy council, being a deliberative body; and at the accession of Henry VII. its powers had become so greatly abridged by restraining statutes as to render it almost inoperative as a court of justice. The statute of 3 Henry VII. (1488) placed the jurisdiction on a permanent basis by establishing a court composed of three high officers of state, to whom a fourth was subsequently added, a bishop and temporal lord of the council, and two justices of the courts of Westminster, which took cognizance of riots, perjury, the misbehavior of sheriffs, and other offences against the administration of justice, without the assistance of a jury. This tribunal was distinct from the council itself, of which it may be considered a committee having delegated powers. It received an augmentation of its powers by act of 31 Henry VIII.; but during the minority of Edward VI. it was merged in the general body of the council, which thenceforth, as in earlier times, constituted the real court of the star chamber. The latter continued under the Tudors and their successors, in spite of numerous restraining statutes, to exercise a jurisdiction, particularly in criminal matters, unauthorized by the act of Henry VII. erecting a new court, and which gradually rendered it one of the

most odious instruments in overthrowing the liberties of the people. Every misdemeanor, and especially those of public importance for which the law had provided no sufficient punishment, seems to have come within the scope of its inquiry. Among these were corruption, breach of trust, and malfeasance in public affairs, attempts to commit felony, or breach of proclamations; and to such an extent was its authority stretched under the Stuarts, that, according to Clarendon, "any disrespect to any acts of state, or to the persons of statesmen, was in no time more penal, and the foundations of right never more in danger to be destroyed." The mode of process was generally by information filed at the suit of the attorney general, or, in certain cases, of a private relator, and in other respects resembled that familiar to the court of chancery. Although the court was held incompetent to pronounce sentence of death, fines, imprisonment, the pillory, whipping, branding, and various species of maiming were freely resorted to. After flourishing with constantly increasing power for upward of a century, as thus constituted, the court of the star chamber was finally abolished by act of parliament in 1641.

**STAR FISH**, the popular name of the radiated animals of the class of echinoderms and the order asterioids, well exemplified by the common species of the New England coasts, the five-fingered Jack of the sailors. The quinary arrangement prevails to a remarkable extent in the star fishes. The body is depressed, and divided into rays like a star; the upper surface is studded with rough knobs, varying in color with the species, but generally reddish or yellowish, between which are the openings of many very minute tubes for the passage of water in and out of the body; the skin is coriaceous, and contains the above named corpuscles, beneath which is a cutaneous skeleton of porous calcareous pieces, movably articulated, and extending on the lower surface from the mouth in the centre to the end of the rays. In the lacunæ between these pieces are the ambulacral pores, along the centre of the lower surface of each ray, through which are protruded the ambulacral tubes; these are the principal organs of locomotion, are arranged in a double or quadrangular row, and are provided with contractile sacs or vesicles on the inner surface of the envelope; the tubes are constantly in motion, each ending in a suctorial disk, and pull the animal along as by the successive action of so many little anchors. On the external edges of the rays are series of stiff spines, probably serving for protection, and at the end of each ray is a small reddish eye speck; there are also scattered over the upper surface small processes ending in calcareous hooks or pincers. The mouth opens into the stomachal cavity, from which branching cæcal tubes extend to the extremity of each arm; they have no long tentacles like the sea anemone (*actinia*), but the stomach can be everted over their food and then be turned back again; the mouth is very dilatable, and will admit large mollusks with the shell, the hard parts being ejected after the soft portions are digested. There is great variety in the spreading, division, and subdivision of the arms, and in the relative size of the central disk, but all are arranged after the radiated plan; the rays can be bent in any direction, according to the will of the animal, by the contractile skin and muscles. The slender ophiurans progress by the undulatory movements of the rays, which, when very slender, long, and branching, have no eyes at the tips; there is generally no anal aperture, and if any it is on the dorsal surface. By the action of cilia water flows through the body, through the aquiferous system, distending and protruding the ambulacral feet, filling the circular vessel around the mouth, and serving for respiration, which, according to Siebold, is performed partly by the vesicular appendages attached to the central ring; all the viscera are bathed in water, and respiration is also effected through the delicate blood vessels thereon distributed. The vascular system is very simple; the nervous ganglia are five, arranged around the mouth, each sending filaments to the arm at whose base it lies; the sense of touch is very acute. According to Sars, Steenstrup, and Lütken, there is not only in this class a great power of regeneration of lost parts, but a spontaneous division of the disk itself, with regeneration of the necessary portions, several times repeated up to a certain age, for the multiplication of the individual. While this may sometimes be a simple division, in many it is the normal mode of multiplication instead of gemmation. This form of agamic multiplication in ophiuroids and asterioids has been called schizogeny. On the upper surface, to one side of the centre and between two of the arms, is a round bright-colored spot, the madreporic plate or body, communicating with a canal leading to the water vessel around the mouth—a supposed filter for water passing into the aquiferous system and through the body. They propagate usually by eggs, and the sexes are in separate individuals; the larvæ are at first oval, ciliated bodies, from which the radiated perfect animal is developed, at various stages of its growth, by a process of internal gemmation. The crinoid *comatula*, or feather star, free when adult, has its young attached on a long slender stem; Sars has traced the growth of *echinaster* from a spheroidal free-moving mass to the perfect star fish. Some species secrete a reddish fluid on the surface, probably the coloring matter, often irritating to the skin of persons handling them; according to Deslongchamps, they can inject a fluid into the shells of their victims, which stupefies and renders them an easy prey. Rymer Jones says star fishes may be considered as mere walking stomachs, their office in the economy of nature being to

devour all kinds of garbage which would otherwise accumulate on the shores; they eat also living crustaceans, mollusks, and even small fish, and are believed to be very destructive to oysters; they are not used as food by man, but are in many places highly esteemed as manure.—For a popular account of the British species, see "History of British Starfishes," by Edward Forbes (London, 1841). For the New England species, see the recently published works of Agassiz. The common star fish of the North American coast (*asterias rubens*, Lam.), generally considered the same as the European species, is too well known to need description; the colors vary from reddish to yellowish, and the diameter from an

Common Star Fish (Asterias rubens).

inch to more than a foot.—The star fishes are found from the Trenton limestone of the lower Silurian epoch down to the present time.

**STARGARD. I.** A town of Prussia, in the province of Pomerania, on the Ihna, navigable by ships, 21 m. E. by S. of Stettin; pop. in 1871, 17,280. It has a Protestant Gothic church, built in the 14th century. It was formerly the capital of Further Pomerania. **II. Preussisch Stargard,** a town in the province of Prussia, on the Ferse, 25 m. S. by W. of Dantzic; pop. in 1871, 5,822. It is surrounded by walls and towers, and was frequently taken by the Poles in the 15th and 16th centuries, and in 1655 by the Swedes.

**STARGAZER,** a spiny-rayed percoid fish of the family *trachinidæ* or weevers, and genus *uranoscopus* (Linn.), so called from the position of the eyes, which look directly upward. The body is elongated, covered with smooth cycloid scales; head depressed, large and wide, bony and rough, with the gape ascending or vertically cleft, the upper jaw the shorter, and the teeth small and crowded on the jaws, palate, and vomer; branchiostegal rays six; dorsals two, of which the first is small and spinous, the second and the anal long; ventrals in front of the large pectorals and on the throat; anus very far forward; air bladder absent. In some of the family the dorsal and opercular spines are capable of inflicting painful wounds; they

Mediterranean Stargazer (Uranoscopus vulgaris).

have the power of raising the eyeballs from and retracting them within their sockets. There are more than a dozen species of the genus, mostly East Indian, of which the best known is the *U. vulgaris* of the Mediterranean, about a foot long, grayish brown above, with irregular series of whitish spots and grayish white below; ugly as it is, some people eat it. This was well known to the ancients, and Aristotle correctly describes the gall bladder as larger than in most other fishes; it is also called *callionymus* by the old authors, and is proverbially referred to by dramatic writers as the emblem of an angry man. On the coast of South Carolina has been found the *U. anoplos* (Cuv.), about 2 in. long, greenish above with minute black dots, and silvery below; the cheeks are unarmed. These fishes live on the bottom in deep water, burying all but the head in the sand or mud, and there lying in wait for prey; they are voracious, and like other ground fish some have sensitive barbels about the mouth; though the gills are widely open, they live a long time out of water; some have a slender fleshy filament in front of the tongue, which can be protruded.

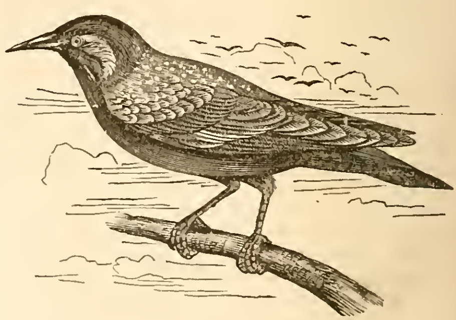
**STARK. I.** A N. E. county of Ohio, drained by the Tuscarawas river and its branches, and traversed by the Ohio canal and several railroads; area, 570 sq. m.; pop. in 1870, 52,508. The surface is undulating and the soil a rich sandy loam. Coal and limestone are abundant. The chief productions in 1873 were 686,418 bushels of wheat, 1,044,317 of Indian corn, 732,897 of oats, 42,376 of barley, 116,597 of potatoes, 44,507 tons of hay, 287,750 lbs. of flax, 246,893 of wool, 932,779 of butter, and 88,705 of cheese. Large quantities of coal and iron are produced. In 1874 there were 13,595 horses, 29,219 cattle, 69,387 sheep, and 25,421 hogs. In 1870 there were 22 manufactories of agricultural implements, 12 of brick, 22 of carriages and wagons, 12 of furniture, 1 of forged and rolled iron, 3 of pig iron, 20 of iron cast-

ings, 18 of tanned and 7 of curried leather, 4 of engines and boilers, 21 of tin, copper, and sheet-iron ware, 5 of woollen goods, 11 breweries, 19 flour mills, 30 saw mills, and 3 planing mills. Capital, Canton. **II.** A N. W. county of Illinois, intersected by Spoon river; area, about 325 sq. m.; pop. in 1870, 10,751. The surface is partly prairie, and the soil is fertile. It is traversed by the Peoria and Rock Island railroad and a branch of the Chicago, Burlington, and Quincy. The chief productions in 1870 were 124,639 bushels of wheat, 30,534 of rye, 1,149,878 of Indian corn, 316,726 of oats, 19,993 tons of hay, 20,789 lbs. of wool, 295,683 of butter, and 17,674 of honey. There were 7,080 horses, 11,558 cattle, 4,226 sheep, and 26,515 swine; 7 manufactories of carriages and wagons, 1 of woollen goods, and 6 flour mills. Capital, Toulon.

**STARK, John,** an American soldier, born at Londonderry, N. H., Aug. 28, 1728, died at Manchester, N. H., May 8, 1822. In 1752, while on a hunting expedition, he was captured by the St. Francis Indians, and remained with them several weeks until ransomed. In 1754 he joined the rangers under Major Rogers in the war against the French and Indians, and in 1757 was made a captain. He rendered efficient services in bringing off the troops after the expedition to Ticonderoga in 1758, and was actively employed in the subsequent campaign. In 1775, after the battle of Lexington, he received a colonel's commission, and enlisted a regiment which formed the left of the American line at Bunker Hill. He was in the expedition against Canada, and remonstrated against Gen. Schuyler's retreat to Ticonderoga. In December, 1776, he marched with his regiment under Gen. Gates to reënforce Gen. Washington. He led the van in the attack upon Trenton, and was in the battle at Princeton. In 1777, the time of his regiment having expired, he returned to New Hampshire and raised a new one; but considering himself unjustly neglected by congress in the list of promotions, he retired from its service. He received a vote of thanks from the New Hampshire legislature, and was placed in command of the troops raised there to oppose the British advance from Canada. Acting upon the authority of the state and his own judgment, he refused to obey the orders of Gen. Lincoln to march to the west of the Hudson, leaving Burgoyne's rear unmolested; and on Aug. 16, 1777, he fought the battle of Bennington, for which congress passed a vote of thanks to him and made him a brigadier general, notwithstanding they had just before censured him for his disobedience of the orders of Gen. Lincoln. He joined Gen. Gates at Bemis's heights, but the term of his militia having expired, he returned to New Hampshire and recruited a new force, with which he cut off Burgoyne's retreat from Saratoga. In 1778 he was placed in command of the northern department; in 1779 and 1780 he served in Rhode Island and New Jersey, and at West Point, and was a member of the court martial which condemned André; and in 1781 he again had command of the northern department, with his headquarters at Saratoga. He lived in retirement after the war, of which he was the last surviving general except Sumter.—See "Life of John Stark," by Edward Everett, in Sparks's "American Biography," 1st series, vol. i., and "Memoirs and Official Correspondence of General John Stark," by Caleb Stark (8vo, Concord, 1860).

**STARKE,** a N. W. county of Indiana, drained by the Yellow and Kankakee rivers, and traversed by several railroads; area, 432 sq. m.; pop. in 1870, 3,888. The surface is level and in many places marshy, with several small lakes, and the soil is fertile. The chief productions in 1870 were 12,449 bushels of wheat, 4,516 of rye, 26,104 of Indian corn, and 4,436 lbs. of wool. There were 1,017 milch cows, 2,403 other cattle, 1,482 sheep, and 2,187 Swine. Capital, Knox.

**STARLING,** or **Stare,** the common name of the conirostral birds of the family *sturnidæ*, and subfamily *sturninæ*, of which the genus *sturnus* (Linn.) is the type; the family also includes the straight-billed birds like the grakles, oxpecker, Baltimore bird, red-winged blackbird, and satin bower bird, separately described. In *sturnus* the bill is long, straight, and sharp, with flattened culmen and tip; wings long and pointed, first quill spurious and second and third nearly equal; tail short and nearly even; tarsi strong and broadly scaled; toes long, including the hind one, the outer united at the base; claws long, curved, and sharp. In habits the starlings resemble the smaller species of the crow family, and the food consists of worms, snails, insects, seeds, and fruits; they are docile in captivity, and may be taught to repeat a few words and to whistle short tunes. They are confined to the old world, migrating in large flocks, preferring swampy places; the flight is rapid and even, accompanied toward

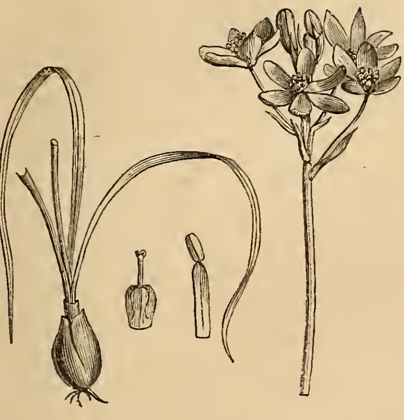


Common Starling (Sturnus vulgaris).

evening by singular circular evolutions; the note is a shrill whistle, with an occasional chatter or imitation of the cry of other birds and of animals; the nest is made of dried grass,

in holes of trees or old buildings, and the eggs are four to six. The best known species is the common starling (*S. vulgaris*, Linn.), about 8 in. long, black, with purple and greenish reflections, and spotted with buff; the female is much less brilliant, and the young males are brownish gray. This bird is found from N. Europe to S. Africa, and in E. Asia, occurring in as large flocks as the allied grakles (*quiscalus*) in North America; in England it often migrates south in October, returning in March; it is frequently kept in cages; the eggs are pale blue.—The American starling (*sturnella magna*, Swains.) has been described under MEADOW LARK. In the genus *pastor* (Temm.) the bill is shorter and more curved; it contains about a dozen species in the old world.

**STAR OF BETHLEHEM,** a name for the plant *ornithogalum umbellatum*, which is also called "eleven-o'clock-lady" (Fr. *dame d'onze heures*), as its flowers open about 11 o'clock; and as they close at 3 o'clock in the afternoon, it is in



Star of Bethlehem (Ornithogalum umbellatum).

some localities known as "Johnny-go-to-bed." It belongs to the lily family, and has a small bulb, from which arise narrow, grass-like leaves, with a white line in the middle, and a scape 6 to 8 in. high, bearing a corymb of a few bright white flowers, consisting of six sepals, which are green in the middle on the outside. A native of southern and central Europe, this was formerly a common garden plant, and has escaped and become naturalized in the older states. The genus *ornithogalum* (Gr. ὄρνις, a bird, and γάλα, milk, a whimsical name) includes several larger and more showy species, cultivated as hardy garden bulbs.

**STARR,** a S. county of Texas, bounded S. W. by the Rio Grande, which separates it from Mexico; area, 2,100 sq. m.; pop. in 1870, 4,154, including 18 colored persons and many Mexicans. There is considerable rich land in the valley of the Rio Grande, producing corn, sugar cane, &c. The rest of the county suffers from lack of water, and is suitable only for stock raising, which is the principal occupation. There are large herds of horses, mules, sheep, and cattle. Capital, Rio Grande City.

**STARVATION.** See ABSTINENCE.

**STASSFURT,** a town of Prussia, in the province of Saxony, on the Bode, 20 m. S. S. W. of Magdeburg; pop. in 1871, 10,327. It has one of the largest salt mines in the world, discovered about 1837, and worked with steam engines since 1856, and extensive manufactories of chemicals. The salt works have been described by Bischof (Halle, 1864), and by Rheinwarth (Dresden, 1871).

**STATEN ISLAND,** an island of New York, constituting with several adjacent islets the county of Richmond, 5 m. S. W. of New York city, from which it is separated by New York bay; length N. E. and S. W. 13 m., greatest breadth 8 m.; area, 58½ sq. m.; pop. in 1870, 33,029; in 1875, 35,241. It is separated from Long Island on the northeast by the Narrows, from New Jersey on the west by Staten Island sound, about ⅓ m. wide, and from the same state on the north by Newark bay and the Kill Von Kull, and is bounded S. E. and S. by the lower bay and Raritan bay. It is divided into five towns, viz.: Castleton, Middletown, Northfield, Southfield, and Westfield. New Brighton (pop. 7,495 in 1870), Port Richmond (3,028), and Tottenville (1,571) are incorporated villages. The surface is mostly level or gently undulating. A broad range of hills, reaching a maximum height of 310 ft., extends E. and W. across the N. portion. Iron ore is found. The island is the residence of a large number of persons engaged in business in New York, with which city it is connected by steam ferries. The Staten Island railroad extends from Clifton at the N. E. to Tottenville at the S. W. extremity. Fort Tompkins and Fort Wadsworth, with several batteries, command the Narrows. The New York quarantine establishment is situated on artificial islands off the E. shore. Staten Island is the seat of the "Sailors' Snug Harbor," a retreat for superannuated seamen, and of a hospital for seamen and an asylum for destitute, sick, and infirm families of seamen, supported by the "Seamen's Fund and Retreat." (See RICHMOND, vol. xiv., p. 319.)

**STATES GENERAL. I.** An assembly of the nation which existed in France previous to the revolution, and consisted of the representatives of the clergy, the nobility, and the third estate (*tiers état*). Before the reign of Philip the Fair, the people or unprivileged class had no voice in the general administration of the kingdom; but that monarch, being involved in his great struggle with the papacy, and desirous to have the whole nation on his side, determined to convene an assembly in which, in addition to the clergy and nobility, the principal inhabitants of the towns, or *bourgeoisie*, forming a third estate, should be represented. The mass of the people, however, never had a voice in these assemblies. The three orders forming the states general

met in Paris in 1302, and by their support induced the king to reassemble them in 1303 and again in 1308, when they voted for the condemnation of the knights templars. The example of Philip was imitated by his successors. During the wars with Edward III. of England the states general acted with such authority in the affairs of the revenue as to make the court dependent on their decisions. The disasters which befell the nobility at Crécy and Poitiers enabled the third estate to play an unusual part at this time. The people of Paris acquired an undue influence, while the provinces were imperfectly represented. In 1357 an ordinance of the dauphin Charles left the raising and disposition of the revenues to the states general, and declared the members inviolable. During the next 80 years they met frequently; but in 1439, by voting a fixed sum for the support of a standing army, they removed one of the principal reasons for their convocation. Henceforward they met at long intervals. A resolution to meet biennially, passed on the accession of Charles VIII. and approved by the court, remained without effect; and finally the kings came to feel that they could rule without the nation. The last meeting before the revolution, that of 1614–'15, was marked by disputes between the orders, in which the third estate was humiliated. In all, the body had assembled about 35 times in three centuries. In place of the states general the kings at times convened an assembly of the notables, or prominent men of all ranks, who, being nominated by the sovereign or the privy council, more readily complied with the royal demands. The notables assembled in 1626 for the last time previous to the reign of Louis XVI., when they were again convoked in 1787 and 1788. These assemblies having shown their inefficiency, the disorders of the kingdom induced Louis XVI. to revive the states general; and on May 5, 1789, their sessions were opened at Versailles. Under the old kings the states general were the only assembly in France which may be said in a measure to have formed a national legislature. Their sessions, however, were very brief, occasionally lasting only a few days, and they were generally called together to vote subsidies or deliberate on the measures of the court, not to devise laws for the state, though they were expected to present their lists of grievances (*cahiers de doléance*) to the sovereign. The assembly voted by orders, which made it easy for the clergy and nobles to thwart the measures of the third estate. Against this division the third estate rose in 1789. They insisted on a vote by members, and carried through their demand by constituting themselves the national assembly. (See CONSTITUTIONAL CONVENTION, and FRANCE, vol. vii., p. 385.)—Several of the provinces not originally included in the French crown, as Brittany, Burgundy, Navarre, Languedoc, and others, possessed special assemblies called *états provinciaux*, to whose approval the demands of the sovereign were submitted. The third estate early obtained a place in these bodies, and in the states of Languedoc they had a vote equal to that of the other orders combined. These assemblies gradually lost their importance, and disappeared with the revolution. **II.** The national assembly of the Dutch republic, consisting of the deputies of the provinces, who were chosen by the provincial assemblies or states. The deputies of each province had one collective vote. The term continues to be the official designation of the Dutch legislature.

**STATICS.** See MECHANICS.

**STATISTICS**, the systematic collection and classification of facts relating to the social and industrial conditions of the people. One of the first to systematize statistics and give to them a scientific character was Gottfried Achenwall, who lectured on that subject in the university of Göttingen about the middle of the 18th century, and gave the name (Ger. *Staat*, state) to the science. A. L. von Schlözer (died 1809), a pupil of Achenwall, developed the science more fully. During the present century marked progress has been made in statistical science. The chief countries of Europe have organized statistical bureaus, departments, or commissions, which collect and publish periodically facts relating to the condition of the people in every phase of life. France, Belgium, Sweden, Prussia, and Italy rank specially high in this respect. In London, Paris, and other European cities are statistical societies which publish periodicals. In 1862 a statistical seminary, for affording instruction in the theory and practice of the science, was established in Berlin, through the efforts of Dr. Engel, and a professorship of statistics was established in the university of that city in 1874. In England statistical reports on the various interests of the United Kingdom are published annually by parliament. In the United States statistics of commerce and navigation are published monthly and annually by the bureau of statistics; those relating to education are published annually by the commissioner of education, and those relating to agriculture by the bureau of agriculture.—Great importance is attached in all countries to the thorough and frequent collection of vital statistics, which are of the highest value in determining questions of health, duration of life, movement of population, &c. As early as 1686 the clergy in Sweden were required to keep registers of marriages, births, and deaths. In most if not all of the countries of Europe these statistics are carefully collected and published periodically. In England they are under the charge of the registrar general, who publishes an annual report. No provision has been made by the United States for the collection of vital statistics except when the decennial censuses are taken. In many of the states, however, records of births, marriages, and deaths are required

to be kept and published at intervals.—The first international statistical congress met in Brussels in 1853; sessions have since been held at Paris, 1855; Vienna, 1857; London, 1860; Berlin, 1863; Florence, 1867; the Hague, 1869; and St. Petersburg, 1872. (See CENSUS.)

**STATIUS, Cæcilius.** See CÆCILIUS STATIUS.

**STATIUS, Publius Papinius**, a Roman poet, born probably in A. D. 61, died probably in 96. His father was a preceptor of the emperor Domitian, by whom the son was patronized. In the Alban contests he three times gained the victory. It has been said that he was a Christian, and that the emperor stabbed him with a *stilus* in a moment of anger. Some details about his life and character have been compiled by Occioni (Padua, 1869). His extant works are: *Silvarum Libri V.*, a collection of 32 poems on passing events, divided into five books; *Thebaidos Libri XII.*, an epic founded upon the legendary account of the expedition of the seven against Thebes, of which the first book was translated into English by Pope; and *Achilleidos Libri II.*, an epic never finished. The best edition is Markland's (1728), revised by Queck (1854). A new critical edition has been published by O. Müller (1870). Five books of the "Thebaid" have been translated into English by Thomas Stephens (8vo, London, 1648), and the entire poem by W. L. Lewis (2 vols. 8vo, Oxford, 1767 and 1773). The "Achilleid" has been translated by Howard (8vo, London, 1660). There is a German translation by Bindewald (1868).

**STATUARY.** See SCULPTURE.

**STATUTE OF FRAUDS.** See FRAUDS, STATUTE OF.

**STATUTES OF LIMITATION.** See LIMITATION, STATUTES OF.

**STAUDENMAIER, Franz Anton**, a German theologian, born at Danzdorf, Würtemberg, Sept. 11, 1800, died in Freiburg, Baden, Jan. 19, 1856. He studied at Tübingen, was ordained a Roman Catholic priest in 1827, became professor of theology at Giessen in 1830 and at Freiburg in 1837, and a canon in 1843, and in 1851 was elected a member of the first chamber of the legislature of Baden. His chief works are: *Geschichte der Bischofswahlen* (Tübingen, 1830); *Encyklopädie der theologischen Wissenschaften* (Mentz, 1834; 2d ed., 1840); *Der Geist des Christenthums* (Mentz, 1835), many times reprinted and translated; and *Die christliche Dogmatik* (4 vols., 1844–'52, not complete), in which he attempts to harmonize the results of modern philosophy with the doctrines of the Catholic church. His other works include *Scotus Erigena und die Wissenschaft seiner Zeit* (vol. i., Frankfort, 1840, unfinished); *Die Philosophie des Christenthums* (vol. i., Mentz, 1840, unfinished); *Darstellung und Kritik des Hegel'schen Systems* (Mentz, 1844); and *Der Protestantismus in seinem Wesen und seiner Entwickelung* (Freiburg, 1846).

**STÄUDLIN, Karl Friedrich**, a German theologian, born in Stuttgart, July 25, 1761, died in Göttingen, July 5, 1826. He studied at Tübingen, and in 1790 became professor of theology at Göttingen. At first he was a rationalist, but he gradually inclined to supernaturalism. His works extend over nearly every department of theology; but those on church history are the most valued, and include *Kirchliche Geographie und Statistik* (2 vols., Tübingen, 1804), the first scientific work on this subject, and *Geschichte der theologischen Wissenschaften* (2 vols., Göttingen, 1810–'11).

**STAUNTON**, a river in the S. part of Virginia, which rises in Montgomery co., among the Alleghany mountains, flows E. and S. E. through a pass in the Blue Ridge, and with Dan river forms the Roanoke at Clarksville, Mecklenburg co. It is 200 m. long, and in the first 20 m. of its course has a fall of 1,000 ft.

**STAUNTON**, a city, county seat of Augusta co., Virginia, on Lewis creek, a tributary of the Shenandoah river, and on the Chesapeake and Ohio railroad at the junction of a branch of the Baltimore and Ohio line, 100 m. direct and 136 m. by rail W. N. W. of Richmond; pop. in 1870, 5,120, of whom 1,535 were colored; in 1875, about 7,000. It is surrounded by a highly productive country, abounding in fine scenery. Stages run to Weyer's and Madison's caves, 18 m., and to the Augusta springs, 12 m. distant. It is the seat of the western state lunatic asylum and of the state institution for the education of the deaf and dumb and the blind, each having fine buildings and grounds. The principal manufactories are two iron founderies, two tobacco factories, and two flour mills. There are three banks, with a capital of $500,000; free public schools, with an attendance of more than 600 white and 300 colored children; a Roman Catholic seminary; Lutheran, Methodist, and Presbyterian female seminaries, having more than 600 pupils; three weekly newspapers; and nine churches, viz.: 2 Baptist (1 colored), 1 Episcopal, 1 Lutheran, 3 Methodist (2 colored), 1 Presbyterian, and 1 Roman Catholic.

**STAUNTON, Sir George Thomas**, an English author, born in Salisbury, May 26, 1781, died in London, Aug. 10, 1859. He was the son of Sir George Leonard Staunton (1737–1801), confidential secretary of Lord Macartney at Madras, and a member of his embassy to China, of which he wrote an account (2 vols. 4to, 1797). George Thomas accompanied his father to China in 1792, afterward studied at Cambridge, and in 1799 went to Canton as secretary of the East India company's factory there, of which he afterward became president. In 1816 he was attached to Lord Amherst's embassy to China, and from 1818 to 1852, with a few intermissions, was a member of parliament. His principal works are: "The Penal Code of the Chinese Empire" (4to, London, 1810); "Narrative of the Chinese Embassy to the Tartar Khan Tourgouth during the Years 1812–'15" (1821); and "Miscellaneous Notices relative to China and the British Commercial Intercourse with that Country" (1822).

**STAUNTON, Howard,** an English author, born in 1810, died in London, June 26, 1874. He was educated at Oxford, but left without taking a degree, and went to London. In 1843 he won a match in Paris over St. Amand, the chess champion, and subsequently conducted the chess column in the "Illustrated London News," and published "The Chess Player's Hand Book" (London, 1847; with supplement, "Chess Praxis," 1860); "Chess Player's Companion" and "Chess Player's Text Book" (1849); and "Chess Tournament" (1852). From 1857 to 1860 he was engaged in editing an edition of Shakespeare; in 1864 he brought out a facsimile of the folio of 1623, and published "Memorials of Shakespeare;" and in 1872 he contributed to the "Athenæum" a series of papers on the "Unsuspected Corruptions of Shakespeare's Text." He also wrote "Great Schools of England" (8vo, 1865).

**STAUPITZ, Johann von,** a German theologian, born in Meissen, died in Salzburg, Dec. 28, 1524. He was an Augustinian monk, obtained from the pope in 1501 general privileges for the newly established university at Wittenberg, of which he was made dean on its opening in 1502, and in 1508 caused Luther to become a professor there. He approved of the theses of Luther against papal indulgences, but not publicly. In 1518 he demanded at Augsburg that Luther should not be condemned unheard and untried. He became court preacher at Salzburg, and in 1522 abbot of a Benedictine convent. He is the author of *De Amore Dei* (Leipsic, 1518), and several other writings of a mystical character.

**STAVANGER,** a town of Norway, capital of a district of the same name, in the province of Christiansand, on the Bukkefiord, 100 m. S. of Bergen; pop. in 1870, 17,058. It has three suburbs, a cathedral dating from the 11th century, a good harbor, about 500 registered vessels, and extensive fisheries. The population in 1801 was barely 2,500.

**STAVROPOL. I.** A government of Russia, in Ciscaucasia, bounded N. by the country of the Don Cossacks and Astrakhan, E. and S. by the Terek territory, and W. by the Kuban territory; area, 26,634 sq. m.; pop. in 1871, 437,118, embracing Russians, Cossacks, Nogai Tartars, Calmucks, Turkomans, Armenians, and others. The government is mostly level and unproductive, contains a number of shallow lakes and swamps, and is watered by the Kuma, Kalauz, and other rivers. **II.** A town, capital of the government, on the Atchla, 185 m. S. E. of Azov; pop. in 1871, 20,927. It is strongly fortified, has several churches and schools, a fine bazaar, manufactories of soap and leather, and an increasing trade with the Asiatic provinces of the empire. The neighboring warm sulphur springs are much frequented.

**STEAM,** the vapor of water. Water, and even ice, at all temperatures, when not confined within impermeable walls, continually give off vapor, the surface particles assuming the gaseous state with a rapidity determined by the temperature of the mass and the nature and density of the superincumbent atmosphere. When confined, this gasification goes on without regard to the character or density of the atmosphere present until the vapor produced, by gradual accumulation, acquires the maximum density and pressure attainable at that temperature; then the formation of vapor ceases. The minimum temperature at which the substance can exist as vapor under a given pressure, and the maximum at which the water can retain its liquid form under that pressure, are the same. This temperature is called the temperature of saturation under the given pressure. When the process just described is carried on in a vessel open to the atmosphere, the issuing vapor mingles with the molecules of that atmosphere as rapidly as formed, and separates only at the surface, until the boiling point is reached, at which temperature the pressure of the vapor becomes equal to that of the atmosphere; the formation of vapor (heat being supplied in sufficient quantity) becomes rapid, and takes place within the mass as well as at the surface; ebullition or boiling begins, the atmosphere is forced aside, and the ascending steam passes off *en masse.* (See Boiling Point.) The temperature of the boiling point varies with the tension of the atmosphere. Its mean temperature in open air at the sea level is 212° F., 100° on the centigrade scale, 80° on the Réaumur scale, and 673·2° on the absolute scale. The temperature of both water and steam in a steam boiler is the boiling point due to the pressure of steam carried. A table of such temperatures and pressures is given below. Superheated steam is that which has a temperature higher than that of saturation at the same pressure. If equal quantities of heat be supplied in equal times, an interval will elapse after the temperature has risen to the boiling point before the water will have become vaporized, which interval will be about 5¼ times that required to heat the liquid from the freezing to the boiling point. Careful experiment has shown that, in the transition from the liquid to the gaseous condition, 5¼ times as much heat is required as to heat the same weight of water from 32° to 212°. The exact ratio is as 180·5 to 966·1; it being necessary to supply 180·5 units of heat to each pound of water to raise it in temperature from the freezing to the boiling point, and 966·1 British thermal units to change it into steam. As no rise of temperature was perceived during this last change of state, this heat was called by Dr. Black latent heat, which name is still retained, although it is now well known that it is this heat which performs the work of vaporization. The quantity of heat required to change water at the boiling point to steam at the same temperature varies with the pressure. Under atmospheric pressure, Dr. Black and James Watt found its amount approximately, and Regnault, who discovered its variation with change of

pressure, determined it with great accuracy for a wide range of temperatures and pressures. At 212° it is 966·1 British thermal units per pound. At any other temperature it is $1091 \cdot 7 - 0 \cdot 695(T° - 32°) - 0 \cdot 000000103(T - 39 \cdot 1°)^3$(Rankine), or nearly 1113·94—0·695 T. The total amount of heat required to raise one pound of water from any given temperature to the temperature of evaporation, and to evaporate it at the latter temperature, or the total heat of evaporation, is often called the total heat of steam. This varies at different temperatures, and is equal to $1091 \cdot 7 + 0 \cdot 305 (T - 32°) - c_2(T_2 - 32°)$, or 1081·94+0·305 T, from 32°. It is nearly 1113·94+0·305 T where the initial temperature is hypothetically 0°. In these expressions, T is the temperature of vaporization, $c_2$ the mean specific heat of water between the freezing point and the temperature of the feed water, and $T_2$ the latter temperature. Reckoning from 212°, the values of latent and total heat become $l = 966 \cdot 1 - 0 \cdot 695(T - 212°)$, and with a given temperature $t$ of feed water, $h' = 1178 \cdot 6 - t + 0 \cdot 305(T - 212°)$, the total heat in the latter case being measured from the initial temperature of the feed water $t$ to that of the steam forming at T° F. For the centigrade scale, these values become $l = 606 \cdot 5 - 0 \cdot 695$ T°, and $h' = 606 \cdot 5 - t + 0 \cdot 305$ (T°—100°). The total heat of steam, expressed in foot pounds of energy, is H=835,000+235·5T. A pound of good coal, used under a good steam boiler, will evaporate 8½ lbs. of water at a temperature of 320° F., and a pressure of 75 lbs. per square inch above the atmosphere, the temperature of the water when entering the boiler being 40°. Here the total heat per pound of water is (1178·6—40)+0·305(320—212)= 1171·54; the heat per pound of fuel is 1171·54 ×8·5=9958·1; and the equivalent evaporation from and at 212° is 9958·1÷966·1=10·31 lbs. of water per pound of coal. The specific heat of steam under constant pressure is 0·480. At constant volume it is 0·365; *i. e.*, the quantity of heat per pound required to raise the temperature of steam, where its expansion is just sufficient to keep its pressure constant, is 0·480 British thermal units; and, when confined within an unchanging space, its pressure rising with its increase of temperature, the heat required per degree is 0·365 units. The thermal unit is the quantity of heat required to raise the temperature of one pound of water one degree at the temperature of maximum density. The value at other temperatures is practically the same.—Steam, when perfectly free from particles of water, is dry, invisible, and in its physical properties similar to other gases. Its density (air=1) is 0·622. In changing in temperature one degree under constant pressure, it absorbs heat equal to 85·77 foot pounds of work. The work of the evaporation of a cubic inch of water at 212° is nearly equal to that of raising a ton one foot. Its coefficient of expansion becomes equal to that of perfect gases at about 18° above the temperature due to its pressure, according to Fairbairn and Tate. Steam expanding while doing work, as in the steam cylinder of an engine, becomes partially condensed. When expanding without doing work it superheats, the difference of total heats at the temperatures of the extremes of pressure becoming observable as sensible heat in the production of this superheating. The elastic force of saturated steam being dependent only upon its temperature, the relation may be expressed by a mathematical formula. Many such formulas have been proposed, none of which are exact. The simplest is Tredgold's, $t = 175\sqrt[6]{A} - 75$, in which $t$ is the temperature F. and A the number of atmospheres of pressure. This is correct, within two degrees, from one up to above 25 atmospheres of pressure, and is much more nearly accurate at the extremes of that range. In Southern's formula, which has been much used by engineers, $P = \left(\frac{t + 51 \cdot 3}{135 \cdot 767}\right)^{5 \cdot 15} + 0 \cdot 1$, in which P is the pressure in inches of mercury. These formulas are now seldom employed, as every work upon this subject contains a table of pressures, temperatures, and volumes. Where great accuracy is required, and no table is at hand, Rankine's formulas, $\log. P = A - \frac{B}{\tau} - \frac{C}{\tau^2}$, and $\frac{1}{\tau} = \sqrt{\frac{A - \log. P}{C} + \frac{B^2}{4C^2}} - \frac{B}{2C}$, may be used. In these formulas, P is the pressure, $t$ absolute temperature (461·2+T° F.), and A, B, and C are constants: A=8·259; log. B=3·436; log. C=5·599; $\frac{B}{2C} = 0 \cdot 00344$; $\frac{B^2}{4C^2} = 0 \cdot 00001184$. The pressure increases with the temperature at a rate which itself also rapidly increases with rise of temperature. The relative volumes of steam and water can be calculated by Pole's formulas: $V = \frac{24250}{P} + 65$; $P = \frac{24250}{V - 65}$; and still more accurately by those of Fairbairn and Tate: $V = 25 \cdot 62 + \frac{49513}{P + 0 \cdot 72}$; $P = \frac{49513}{V - 25 \cdot 62} - 0 \cdot 72$. The relative volume or density of steam under varying pressure can be computed by the use of Rankine's formula, $\frac{V}{V'} = \left(\frac{P'}{P}\right)^{\frac{16}{17}}$, in which V and P are the volumes in cubic feet, and the pressure reckoned above a vacuum, in pounds per square inch, of one pound of steam at the given pressure, and V′ is the volume (26·36 cubic feet) of one pound of steam at P′, the atmospheric pressure. A cubic inch of water makes about a cubic foot of dry steam. Steam expanding in the cylinder of a steam engine does not follow the law of expansion of permanent gases, nor does the variation of the ratio of pressure to volume follow any law which has yet been exactly expressed mathematically. Rankine considers that pressure varies inversely as the $\frac{10}{9}$ power of the volume, where the steam neither gains nor loses heat, and as the reciprocal of the $\frac{11}{10}$ power where kept dry by a steam jacket. More exactly,

$PaV^{-1.0646}$, and log. $V = 2.516 - 0.939$ log. P. In the following table constant multipliers are given, the product of which into the initial pressure will give the mean or the terminal pressure for the grade of expansion selected:

MEAN AND TERMINAL PRESSURES (SALTER).

| POINT OF CUT-OFF. | CONSTANT. | | DRY AND SATURATED. | | CONDENSING BY WORKING. | |
|---|---|---|---|---|---|---|
| | Mean. | Terminal. | Mean. | Terminal. | Mean. | Terminal. |
| $\frac{1}{8}$ ....... | 0·385 | 0·125 | 0·369 | 0·110 | 0·357 | 0·099 |
| $\frac{1}{6}$ ....... | 0·465 | 0·167 | 0·449 | 0·149 | 0·437 | 0·137 |
| $\frac{1}{5}$ ....... | 0·522 | 0·200 | 0·506 | 0·181 | 0·495 | 0·167 |
| $\frac{1}{4}$ ....... | 0·597 | 0·250 | 0·582 | 0·229 | 0·571 | 0·214 |
| $\frac{3}{8}$ ....... | 0·743 | 0·375 | 0·732 | 0·353 | 0·723 | 0·336 |
| $\frac{1}{2}$ ....... | 0·847 | 0·500 | 0·839 | 0·479 | 0·833 | 0·468 |
| $\frac{3}{4}$ ...... | 0·966 | 0·750 | 0·964 | 0·737 | 0·962 | 0·726 |

—A mixture of steam and other gas has a tension which is equal to the sum of the tensions of the two components. Thus, if a cubic foot of air at atmospheric pressure be enclosed in a vessel of that capacity, and if a cubic foot of steam of the same tension be introduced with it, the pressure upon the walls of the vessel will be two atmospheres, the temperature of both gases being the same. Steam formed from sea water is liberated at a higher temperature than when formed from pure water. The boiling point of water is raised about 0·04° F. for each increment of 1 per cent. of its own weight of salt. Sea water, containing $\frac{1}{32}$ of its weight of salt, boils at 213·2° under atmospheric pressure. The maximum proportion of salt permitted in marine steam boilers is usually $\frac{2}{32}$, the boiling point being raised 2·4° F. Steam, as worked in the steam engine, if not dried by superheaters, is wet; *i. e.*, it carries in suspension fine particles of water. The amount of water so suspended has been found by Prof. Thurston to be from 0·03 to 0·20 of the weight of the mixture. Ten per cent. is a usual proportion with good boilers. The amount was determined by condensing in a calorimeter a determinable weight of the mixture, by the use of a known weight of water, and noting the rise in temperature of the latter. Knowing the temperature due to the steam pressure, the weights of steam and water can be determined. The principal advantage of superheating is an increase of economy due to the thorough expulsion of water from the vapor, and consequent reduction of loss by condensation and revaporization in the steam engine cylinder. A less degree of improvement is due to the simple increase of temperature, and to the consequent widening of the range of temperature within which it is worked. The most elaborate and most accurate experimental determination of the coincident temperatures, pressures, and volumes of saturated steam were made by Regnault, at the expense of the French government, and under the auspices of the academy of sciences, and published in the *Mémoires de l'académie* for 1847. The following table gives a summary of the properties of steam based upon Regnault's determinations. Pressures are given in pounds per square inch above a vacuum, and in inches of mercury measuring from the same point. Volumes are relative to water at its greatest density. Weights are given in pounds, and specific gravity is referred to air as unity at a temperature of 32° F. The distribution of heat in each pound of steam evaporated at 212° F. is given as follows:

| | Units of heat. | Mechanical equivalent, in foot pounds. |
|---|---|---|
| A. The sensible heat: | | |
| 1. To heat the water from 32°, or through 180° .................... | 180·9° = | 139,655 |
| B. The latent heat: | | |
| 2. To convert the water to vapor, irrespective of pressure on surface | 892·9° = | 689,242 |
| 3. To advance against and remove the incumbent atmosphere, whether air or previously generated steam, its pressure being 2,116·8 lbs. per square foot of surface.... | 72·3° = | 55,815 |
| Total latent heat.................. | 965·2° = | 745,057 |
| Total heat of steam............... | 1,146·1° = | 884,712 |

It is evident that the total latent heat of steam cannot be taken as in any way the measure of the energy or work in, or that can practically be obtained from, the steam. Much the larger part of such heat is expended in merely overcoming the cohesion of the liquid; and at all temperatures but a small fraction of the latent heat can be made available in performing work. Of the total, seven tenths is lost through the existence of natural conditions over which man can probably never expect to obtain control, two tenths through imperfections of mechanism, and but one tenth is utilized in even good engines.

PROPERTIES OF SATURATED STEAM.

| PRESSURE. Lbs. per sq. in. | PRESSURE. Inches of mercury. | Temperature in degrees. | Latent heat in degrees. | Total heat in degrees from zero. | Relative volume. | Weight of 1 cubic foot. | Specific gravity. |
|---|---|---|---|---|---|---|---|
| 1 | 2·0 | 102·0 | 1,043·0 | 1,145·0 | 20,620 | 0·0030 lb. | 0·037 |
| 5 | 10·2 | 162·3 | 1,000·7 | 1,163·4 | 4,535 | 0·0137 | 0·170 |
| 10 | 20·4 | 193·2 | 979·0 | 1.172·9 | 2,360 | 0·0264 | 0·327 |
| 14·7 | 30·0 | 212·0 | 966·1 | 1,178·6 | 1,644 | 0·0379 | 0·470 |
| 15 | 30·5 | 213·0 | 965·0 | 1,178·9 | 1,612 | 0·0387 | 0·480 |
| 20 | 40·7 | 227·9 | 954·4 | 1,183·5 | 1,220 | 0·0511 | 0·633 |
| 25 | 50·9 | 240·0 | 945·8 | 1,187·1 | 985 | 0·0634 | 0·786 |
| 30 | 61·1 | 250·2 | 938·9 | 1,190·3 | 827 | 0·0755 | 0·935 |
| 35 | 71·3 | 259·2 | 932·2 | 1,193·0 | 713 | 0·0875 | 1·085 |
| 40 | 81·4 | 267·1 | 926·5 | 1,195·4 | 628 | 0·0994 | 1·232 |
| 45 | 91·6 | 274·3 | 921·3 | 1,197·6 | 562 | 0·1111 | 1·377 |
| 50 | 101·8 | 280.9 | 916·6 | 1,199·6 | 508 | 0·1227 | 1·521 |
| 55 | 112·0 | 286 9 | 912·3 | 1,201·4 | 465 | 0·1343 | 1·664 |
| 60 | 122·2 | 292·5 | 908·2 | 1,203·2 | 428 | 0·1457 | 1·805 |
| 65 | 132·3 | 297·8 | 904·5 | 1,204·8 | 398 | 0·1570 | 1·946 |
| 70 | 142·5 | 302·7 | 900·9 | 1,206·3 | 371 | 0·1682 | 2·084 |
| 75 | 152·7 | 307·4 | 897·5 | 1,207·7 | 348 | 0·1792 | 2·221 |
| 80 | 162·9 | 311·8 | 894·3 | 1,209·0 | 328 | 0·1901 | 2·357 |
| 85 | 173·1 | 316.0 | 891·3 | 1,210·3 | 310 | 0·2010 | 2·492 |
| 90 | 185·2 | 320·0 | 888·4 | 1,211·6 | 295 | 0·2118 | 2·625 |
| 95 | 193·4 | 323·9 | 885·6 | 1,212·7 | 281 | 0·2225 | 2·757 |
| 100 | 203·6 | 327·6 | 882·9 | 1,213·8 | 268 | 0·2330 | 2·887 |
| 105 | 213·8 | 331·1 | 880·3 | 1,214·9 | 256 | 0·2434 | 3·016 |
| 110 | 224·0 | 334·5 | 877·9 | 1,216·0 | 246 | 0·2538 | 3·144 |
| 115 | 234·1 | 337.8 | 875·5 | 1,217·0 | 236 | 0·2640 | 3·272 |
| 120 | 244·3 | 341·0 | 873·1 | 1,218·0 | 228 | 0·2743 | 3·399 |
| 125 | 254·5 | 344·1 | 870·9 | 1,218·9 | 220 | 0·2843 | 3·523 |
| 150 | 305·4 | 358·2 | 860·6 | 1,223·2 | 187 | 0·3340 | 4·139 |
| 200 | 407·2 | 381·6 | 843·4 | 1,230·3 | 147 | 0·4250 | 5·266 |

—See King, "Lessons and Practical Notes on Steam," &c. (New York, 1860; 19th ed., 1873); Fairbairn, "Useful Information for Engineers" (3 series, London, 1864–'6); Salter, "Economy in the Use of Steam" (London, 1874); Perry, "An Elementary Treatise on Steam" (London, 1874); *Relation des expériences de M. V. Regnault* (Paris); and Porter, "Steam Engine Indicator," containing a valuable steam table (New York, 1875).

**STEAM BOILER.** The use of steam boilers dates from antiquity. Hero, who lived in the 3d century before the Christian era, described several forms of boilers which were used in generating steam for what seem to have been a variety of philosophical toys, one of which is generally referred to as the earliest known example of the steam engine. When steam began to be usefully applied, and considerable pressures became necessary, the forms given to boilers were approximately spherical, ellipsoidal, or cylindrical. Thus the boilers of De Caus (1615) and of the marquis of Worcester (1663) were spherical; those of Savery (1698) were ellipsoidal and cylindrical. After the invention of the steam engine of Newcomen, the pressures adopted were again very low, and steam boilers received irregular forms until, at the beginning of the present century, they were again of necessity given stronger shapes. The material was at first frequently copper; it is now usually wrought iron, and sometimes steel.—The present forms of steam boilers may be classified as plain, flue, and tubular boilers. The plain cylindrical or common cylinder boiler is the only representative of the first class in common use. It is perfectly cylindrical, with heads either flat or hemispherical. There is usually attached to the boiler a "steam drum" (a smaller cylindrical vessel), from which the steam is taken by the steam pipe. This enlargement of the steam space permits the mist, held in suspension by the steam when it first rises from the surface of the water, to separate more or less completely before the steam is taken from the boiler.—Flue boilers are frequently cylindrical, and contain one or more cylindrical flues which pass through from end to end, beneath the water line, conducting the furnace gases, and affording a greater area of heating surface than can be obtained in the plain boiler. A cylindrical boiler, having one flue traversing it longitudinally, is called a Cornish boiler, as it is generally supposed to have been first used in Cornwall. It was probably first invented by Oliver Evans in the United States, previous to 1786, at which time he had it in use. The flue has usually a diameter 0·5 or 0·6 the diameter of the boiler. A boiler containing two longitudinal flues is called the Lancashire boiler. This form was also introduced by Oliver Evans. The flues have one third the diameter of the boiler. Several flues of smaller diameter are often used, and when a still greater proportional area of heating surface is required, tubes of from 1¼ in. to 4 or 5 in. in diameter are substituted for flues. The flues are usually constructed by riveting sheets together as in making the shell or outer portion. They are sometimes welded by British manufacturers, but rarely if ever in the United States. Tubes are always "lap-welded" in the process of rolling them. Small tubes were first used in the United States, about 1785. In portable, locomotive, and marine steam boilers, the fire must be built within the boiler itself, instead of (as in the above described stationary boilers) in a furnace of brickwork exterior to the boiler. The flame and gases from the furnace or fire box in these kinds of boiler are never led through brick passages *en route* to the chimney, as often in the preceding case, but are invariably conducted through flues or tubes, or both, to the smoke stack. These boilers are also sometimes used as stationary boilers. Fig. 1 represents a steam fire engine boiler in section, as usually exhibited in working drawings. F is the furnace, W the water space, and S the steam space. This is the form of boiler adopted for the steam fire engine described in the article FIRE ENGINE. In these boilers the fire is usually urged by the blast produced by the exhaust from the engine cylinder, and is thus rendered very intense. The tubes are frequently made of brass or of copper, to secure rapid transmission of heat to the water, and thus to permit the use of a smaller area of heating surface and a smaller boiler. The steam space is made as large as possible, to secure immunity from "priming" or the "entrainment" of water with the steam. This type of steam boiler was the earliest of the tubular boilers. It was invented by Nathan Read of Salem, Mass., in 1791, and patented in April of that year. In the locomotive boiler, fig. 2, as in the preceding, the characteristics are a fire box at one end of the shell and a set of tubes through which the gases pass directly to the smoke stack. Strength, compactness, great steaming capacity, fair economy, moderate cost, and convenience of combination with the running parts are secured by the adoption of this form. It is frequently used also for portable and stationary engines. It was invented in France by M. Séguin, and in England by Booth, and

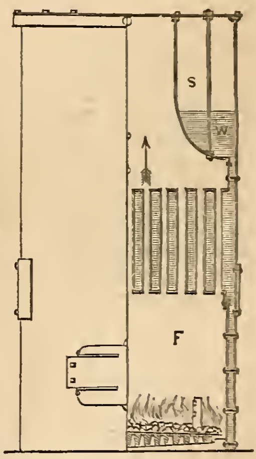


FIG. 1.—Steam Fire Engine Boiler.

used by George Stephenson contemporaneously, in 1828 or 1829. Fig. 3 is a common form of marine steam boiler. It is used very extensively in the United States when the steam pressure does not exceed 40 or 45 lbs. to the square inch. The gases, leaving the furnace F, pass to the "back connection" through large flues; there turning, as

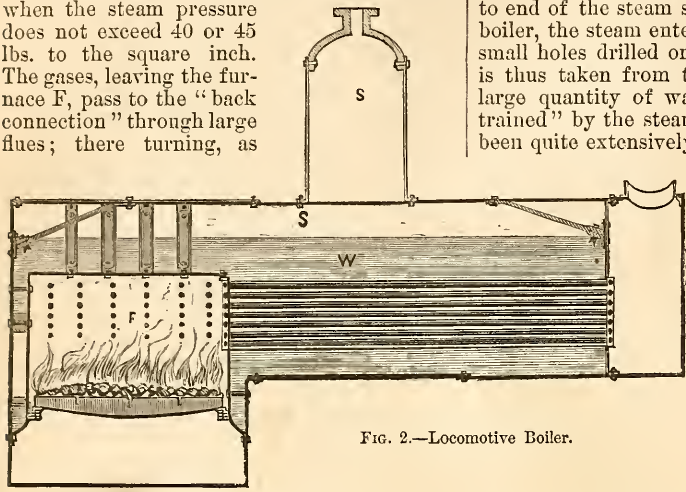



Fig. 2.—Locomotive Boiler.

shown by the arrow, they return to the front through the tubes, and from the "front connection" rise into the chimney. Large steam space is secured in this boiler by a steam drum, as in the locomotive boiler; but here the chimney passes through the steam drum, and thus this "steam chimney," as it is called, is made more useful in drying the steam and in economizing heat. The circular shell, the well stayed surfaces of the fire box and the ends, the convenient distribution of parts, and their excellent relative proportions, make this one of the most satisfactory of all types of boilers which are suitable for moderate pressure. Fig. 4 is a type of marine tubular boiler which is in most extensive use in seagoing steamers for moderate pressure, and particularly for naval vessels. Here the gases pass directly into the back connection from

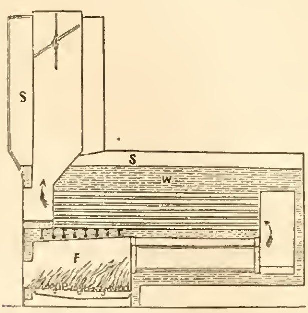



Fig. 3.—Marine Flue and Tube Boiler.

the fire, and thence forward again, through horizontal tubes, to the front connection and up the chimney. In naval vessels the steam chimney is omitted, as it is there necessary to keep all parts of the boiler as far below the water line as possible. Steam is taken from the boiler by pipes which are carried from end to end of the steam space, near the top of the boiler, the steam entering these pipes through small holes drilled on the upper side. Steam is thus taken from the boiler "wet," but no large quantity of water can usually be "entrained" by the steam. A marine boiler has been quite extensively introduced into the United States navy, in which the gases are led from the back connection through a tube box around and among a set of upright water tubes, which are filled with water, circulation taking place freely from the water space immediately above the crown sheet of the furnace up through these tubes into the water space above them. These "water-tubular" boilers have a slight advantage over the "fire-tubular" boilers already described in compactness, in steaming capacity, and in economical efficiency. They have a very marked advantage in the facility with which the tubes may be scraped, or freed from the deposit when a scale of sulphate of

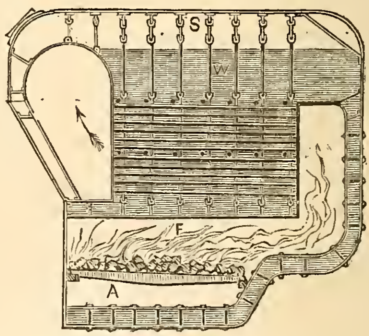
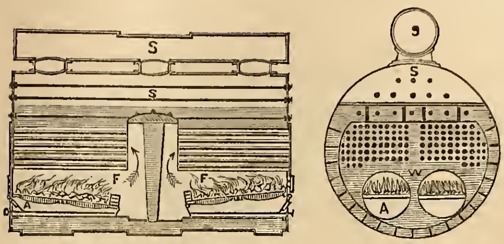



Fig. 4.—Marine Fire-tubular Boiler.

lime or other salt has formed within them by precipitation from the water. The fire-tubular boiler excels in convenience of access for plugging up leaking tubes, and is much less costly than the water-tubular. The water-tube class of boilers still remain in extensive use in the United States naval steamers. They have never been much used in the merchant service, although introduced by Montgomery in the United States and by Lord Dundonald in Great Britain twenty years ago. Opinion still remains divided among engineers in regard to their relative value. They are gradually reassuming prominence by their intro-

duction in the modified form of sectional boilers. The earliest water-tubular boilers were those of Voight, Rumsey, and Fitch, and were invented and known as "pipe boilers" as early as 1785. One of these, consisting of a "collection of long pipes bent so as to cross each




Longitudinal Section. Cross Section.

Figs. 5 and 6.—Marine High-Pressure Boiler.

other like the worm of a still," was used in one of John Fitch's boats in 1788; another form was adopted in the Babcock, built by John Babcock and R. L. Thurston in 1825. (See "American Journal of Science," March, 1827.) Where steam pressure exceeds about 30 lbs. to the square inch in marine boilers, they are now usually given the form shown in section in figs. 5 and 6. This form of boiler is adopted where steam pressures of 60 lbs. and upward are carried, as in steam vessels supplied with compound engines, cylindrical forms being considered the best with high pressures. The large cylindrical flues, therefore, form the furnaces as shown in the transverse sectional view. The gases rise, as shown in the longitudinal section, through the connection, and pass back to the end of the boiler through the tubes, and thence, instead of entering a steam chimney, they are conducted by a smoke connection, not shown in the sketch, to the smoke funnel or stack. In merchant steamers, a steam drum is often mounted horizontally above the boiler. In other cases a separater is attached to the steam pipe between boilers and engines. This usually consists of an iron tank, divided by a vertical partition extending from the top nearly to the bottom. The steam, entering the top at one side of this partition, passes underneath it, and up to the top on the opposite side, where it issues into a steam pipe leading directly to the engine. The sudden reversal of its course at the bottom causes it to leave the suspended water in the bottom of the separater, whence it is drained off by pipes.—Sectional steam boilers are a class of tubular boilers which differ from ordinary forms in their peculiar arrangement of water and steam space. These spaces are divided into a large number of small compartments, and it becomes thus comparatively easy to secure a large "factor of safety," the tubes of which such boilers are usually composed being capable of sustaining many times the pressure proposed to be carried within them.

The boilers are composed either of a series of water tubes, of such tubes attached to larger reservoirs containing water or steam or both, or of a collection of spherical vessels. The earliest real sectional steam boilers were probably that used by Col. John Stevens of Hoboken, on the Hudson river, in 1804, and another which was patented in Great Britain in June, 1805, by his son John Cox Stevens. The first boiler is shown in fig. 7. The inventor says in his specifications: "The principle of this invention consists of forming a boiler by means of a system or combination of small vessels, instead of using, as is the common mode, one large one; the relative strength of the materials of which these vessels are composed increasing in proportion to the diminution of capacity." The steamboat boiler of 1804 was built to bear a working pressure of over 50 lbs. to the square inch, at a time when the usual pressures were from 4 to 7 lbs. It consists of two sets of tubes, closed at one end by solid plugs, and at their opposite extremities screwed into a stayed water and steam reservoir, which was strengthened by hoops. The whole of the lower portion was enclosed in a jacket of iron lined with non-conducting material. The fire was built at one end, in a furnace enclosed in this jacket. The furnace

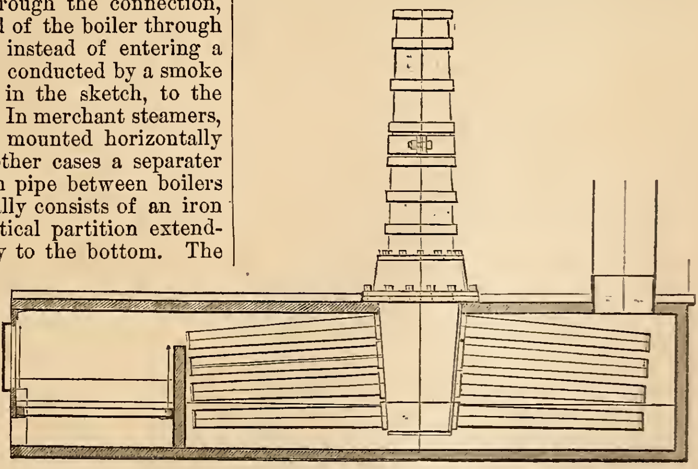


Fig. 7.—John Stevens's Sectional Boiler, 1804.

gases passed among the tubes, down under the body of the boiler, up among the opposite set of tubes, and thence to the smoke pipe. In the second form, as applied to a locomotive in 1825, the tubes were set vertically in a double circle surrounding the fire. These boilers are

preserved in the collections of the Stevens institute of technology, Hoboken. Walter Hancock constructed boilers for his steam carriage of flat plates connected by stay bolts, several such sections composing the boiler; and about the same time (1828) Sir Goldworthy Gurney constructed for a similar purpose boilers consisting of a steam and a water reservoir, placed one above the other, and connected by triangular water tubes exposed to the heat of the furnace gases. Jacob Perkins made many experiments looking to the employment of very high steam pressures, and in 1831 patented a boiler of this class, in which the heating surfaces nearest the fire were composed of iron tubes, which tubes also served as grate bars. The steam and water space was principally comprised within a comparatively large chamber, of which the walls were secured by closely distributed stay bolts. For extremely high pressures boilers composed only of tubes were used. Dr. Ernest Alban about 1843 reproduced the boiler described in the patent of John Stevens (1805), and published a work on "The High-Pressure Steam Engine," in which he described its construction and operation, and declared that he had experimented with pressures as high as 1,000 lbs. to the square inch (which pressure Perkins also attained), at which point the temperature of the steam was sufficiently high to char slightly the hemp packing of his engine. The Harrison steam boiler, which has been many years in use in the United States, consists of several sections, each of which is made up of hollow globes of cast iron communicating with each other by necks cast upon the spheres, and fitted together with faced joints. Long bolts, extending from end to end of each row, bind the spheres together. (See fig. 8.) An example of another modern type

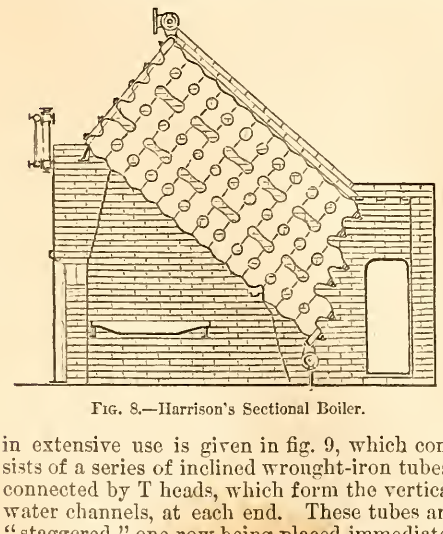


Fig. 8.—Harrison's Sectional Boiler.

in extensive use is given in fig. 9, which consists of a series of inclined wrought-iron tubes, connected by T heads, which form the vertical water channels, at each end. These tubes are "staggered," one row being placed immediately above the space between two rows below it. The joints are faced by milling them, and then ground so perfectly tight that a pressure of 500 lbs. to the square inch is insufficient to produce leakage. No packing is used. The fire is made under the front and higher end of the tubes, and the products of combustion pass

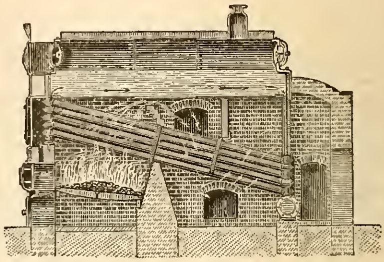


Fig. 9.—Babcock and Wilcox's Sectional Boiler.

up between the tubes into a combustion chamber under the steam and water drum; hence they pass down between the tubes, then once more up through the space between the tubes, and off to the chimney. The steam is taken out at the top of the steam drum near the back end of the boiler. The rapid circulation prevents to some extent the formation of deposits or incrustations upon the heating surfaces, sweeping them away and depositing them in the mud drum, whence they are blown out. Rapid circulation of water, as has been shown by Prof. Trowbridge, also assists in the extraction of the heat from the gases, by the presentation of fresh water continually as well as by the prevention of incrustation. A sectional steam boiler like that illustrated in fig. 8 is one of the best examples of this class of steam generator. It is immensely stronger, is fairly economical of fuel, and is durable when properly managed. The sudden introduction of a large volume of cold water, which is liable to produce leaks from some of its numerous joints, is the most serious injury to be apprehended. It is almost absolutely safe from explosion, and should a globe explode, the danger to its surroundings is comparatively slight. The disadvantages of this type are the small amount of water and of steam room, which causes a difficulty in securing regularity of steam supply, and makes necessary very careful and skilful management. In the boiler illustrated in fig. 9 the last objection is avoided by the use of the large steam and water drum. Some additional risk is thus incurred; but, as the flames are interrupted by the numerous tubes interposed between the drum and the fire, the liability of injury to the drum is too slight to be considered. Attempts have been made to adapt sectional boilers to marine engines; but very little progress has yet been made in their introduction. The Root sectional boiler, an American design, which is in extensive use in the United States and Europe, has been experimentally placed in service on shipboard. Its

heating surfaces consist wholly of tubes. They are connected by a peculiarly formed series of chambered caps, and the ends are made tight by packing with India-rubber grummets.—The proportions of steam boilers vary with the type, and are to some extent determined by special considerations. Efficiency is affected by the proportions of area of heating surface to fuel consumed, of area of grate surface to the same quantity, and by general arrangement of parts. The method of producing draught and the intensity of combustion are also influential in a great degree in determining efficiency. The efficiency of the boiler is to be studied in two parts: the efficiency of the furnace proper, or of the heat-generating apparatus, and that of the boiler proper, or of the heat-absorbing apparatus. In securing efficiency, the engineer first seeks to obtain the highest possible temperature of furnace by thorough combustion of the fuel with a minimum quantity of air. An excess of air, by diluting the products of combustion, diminishes the temperature of the furnace gases. As shown by Prof. Thurston, the abstract efficiency of the furnace in any ordinary case is represented by the formula, $E=\frac{\tau_1-\tau_2}{\tau_1-\tau_3}=\frac{T_1-T_2}{T_1-T_3}$, where E represents the efficiency and $\tau_1$ and $\tau_2$ are the absolute temperatures at which the heat is generated, and at which wasted heat is discharged, and $\tau_3$ that of the external air. $T_1$, $T_2$, $T_3$ are temperatures on the Fahrenheit scale. Suppose, in two instances, the temperatures of furnace gases, including excess of air, were 2118° F. and 919° F. respectively, and that the corresponding temperatures of chimney were 544° and 452°, while the temperature of external air was 74° and 86·5°. In these cases $E=\frac{2118^\circ-544^\circ}{2118^\circ-74^\circ}=0{\cdot}77$; and $E=\frac{919^\circ-452^\circ}{919^\circ-86{\cdot}5^\circ}=0{\cdot}56$; and the first is nearly 40 per cent. higher than the second. By increasing the temperature of the furnace in the first case to 2644°, which is not an unusual figure, the available heat becomes $E=\frac{2644^\circ-544^\circ}{2664^\circ-74^\circ}=0{\cdot}81$ of the whole amount generated. The remaining 19 per cent. passes up the chimney, producing or assisting in the production of draught. Where fuel is wet, a portion of the lost heat disappears in vaporizing the water contained in the fuel. The highest temperature attainable without dilution of gases by an excess of air is given by Prof. Rankine at 4580° F. with pure carbon, and 5050° with olefiant gas. With the more usual case, in which the air supplied is double that theoretically demanded, these temperatures are reduced to 2440° and 2710°. The rate of combustion of good coal, per square foot of grate per hour, depends upon the height of the chimney. This rate is stated by Prof. Thurston as equal to one pound less than twice the square root of the height of the chimney in feet; *i. e.*, $W=\sqrt{H}-1$. Rankine determines the height of chimney by the formula, $H=h\div\left(0{\cdot}96\frac{t_1}{t_2}-1\right)$, in which H is the height of chimney, $h$ the "head" required to produce the draught, as obtained from Peclet's formula, $h=\frac{V^2}{2g}\left(13+\frac{0{\cdot}012l}{m}\right)$, and $t_1$ and $t_2$ the absolute temperatures of the chimney and of the air. In Peclet's formula, V is the velocity of flow, $l$ is the length of chimney and flue, and $m$ is its "hydraulic mean depth." For ordinary practice, Isherwood found the proportion of chimney cross section to area of grate to be about one eighth. Probably a good rule for general practice would be: Make the area for draught one seventh at the bridge wall, one eighth through the flues, and one ninth in the chimney, of the area of grate. The area of heating surface determines the efficiency of the steam boiler as a heat-absorbing apparatus and reservoir. Rankine has given a formula ("Steam Engines and Prime Movers," p. 292, § iv.) for determining the efficiency of fuel in ordinary steam-boiler practice, where the ratio of the area of heating surface, and of fuel burned per hour, to the square foot of grate surface, is known: $\frac{E'}{E}=\frac{B\ S}{S+A\ F}$, in which $\frac{E'}{E}$ is the quantity called above E, A and B are constants, and F and S are the ratio of fuel burned per hour to the square foot of grate, and the ratio of area of heating surface of grate area. The effect of exceptionally low temperature of furnace is to equalize the value of heating surface; and the considerable velocity of the gaseous current, which is a consequence of the unusually great volume of air passing through the furnace, increases this effect. The nearer surface is inefficient, and the most distant portions of the heating surface are therefore proportionally much more efficient than in the preceding case. ("Transactions of the American Society of Civil Engineers," 1874–'5, pp. 290, 303.) With high temperature and slow movement of gases, a lower relative amount of heating surface is efficient; and with lower temperature of furnace and rapid movement of gases, the heating surface must be extended beyond the proportions upon which this estimate is based. The constants A and B have values varying from 1 and 0·5 respectively, in the best designed boilers, to 0·9 and 0·5 in ordinary cases, both having chimney draught, and to 0·95 and 0·3 for cases of ordinary practice with forced draught. These values are changed very slightly by wide ranges of proportions of heating and grate surfaces, or of the value of $\frac{F}{S}$. The value of F has already been given. The value of S is variable with the style of boiler used, and with the value of fuel. The ratio S of area of heating surface to grate area, in ordinary good practice, and under ordinary conditions, may be taken at 15 with plain cylindrical boilers, 20 with Cornish, 25 with flue, 28 with fire-tubular, and 30 with

water-tubular boilers having moderate draught. In locomotive and other boilers with forced draught, the ratio of heating to grate surface rises to from 50 to 100 to 1. For the sizes of the parts of steam boilers exposed to strain, see STRENGTH OF MATERIALS.—Burned in the furnace of good steam boilers, a cord of dry yellow pine, in the experiments of Prof. Walter R. Johnson, evaporated 12,618·3 lbs. of water. A cord of dry yellow pine is approximately equal in heating power to 0·6 of a ton of coal, and a ton of good coal is equal in calorific power to 1·66 cord of soft wood. As an average, a pound of dry wood is theoretically capable of evaporating 6·66 lbs. of water from and at 212° F. Similarly, a pound of good anthracite should evaporate 13·5 lbs. of water. (See FUEL.) Incomplete combustion is caused by an insufficient supply of air, by imperfect intermixture of air and combustible gases from the fuel, and by the falling of fuel through the grate into the ash pit. These losses are usually largely due to unskilful management, and they amount frequently to 15 per cent. They are sometimes due to defects of design. Loss of efficiency is also produced, as already shown, by excessive air supply, which, while insuring complete combustion, lowers the temperature of the furnace. Losses occur by conduction and radiation of heat from the boiler, the furnace, or the flues. This can usually be reduced to a very small amount by properly protecting the apparatus by non-conducting covering. Loss may occur by the passage of the gases to the chimney before their temperature has been reduced to that required for draught. This can be prevented by providing a sufficient extent of heating surface.—Incrustation and deposits are produced by the precipitation upon the interior of the boiler of substances held in solution or in suspension by the water. Sea water precipitates sulphate of lime, and, passing a concentration of $\frac{1}{3\frac{3}{3}}$, or when it contains 36·37 per cent. of salt, it precipitates the excess. River waters produce scales composed of lime carbonates and sulphates and various other mineral salts.—The horse power of a steam boiler is an indefinite and inappropriate term. It was formerly assumed that the evaporation of a cubic foot of water would yield sufficient steam to drive an engine of one horse power one hour. A moderately good modern engine should not use more than half this amount, and a good boiler should evaporate half a cubic foot an hour for each 12 sq. ft. of heating surface. A good engine of 100 horse power would therefore be supplied with steam by a good boiler of 1,200 sq. ft. area of heating surface. The most economical engines recently built use only about one fourth of a cubic foot or 16 lbs. of water per horse power per hour.—Steam boiler explosions occur as a consequence of ignorance or carelessness in design, in construction, or in management. Experimental explosions in Great Britain, and notably in the United States, have shown that even low pressures are sufficient to produce very violent explosions. The explosion experiments of Francis B. Stevens, in November, 1871 (reported by R. H. Thurston in "Journal of the Franklin Institute," 1872), were considered to indicate: 1, that a most violent explosion may occur in a boiler well supplied with water; 2, that what is generally considered a moderate steam pressure may produce a very violent explosion of a weak boiler containing a large body of water, and having all its flues well covered. The same writer estimated that one of the boilers exploded by Mr. Stevens contained 40,000 lbs. of water; and that when the steam pressure was, as at the time of explosion, 53 lbs. to the square inch, the heat stored in the boiler amounted to 2,674,080 British thermal units, equivalent in mechanical energy to about 2,064,389,760 foot pounds, or, if wholly so expended, sufficient to raise the whole boiler, weighing 70,000 lbs., to a height of 29,491 ft., or more than five miles. The conclusion reached was: "That it is very certain that the energy of this explosion, and all of its tremendous effects, were principally due to the simple expansion of a mass of steam suddenly liberated at a moderate pressure, by the general disrupture of a steam boiler of very uniform but feeble strength." When steam boilers are locally weak, explosion rarely occurs. The steam pressure produces rupture at the weakest point, and, the strength of surrounding parts being sufficient to prevent extension of the break, no explosion occurs. Where the weakest portions of the boiler are more extended and more uniformly weak, the extent of the rupture which finally occurs becomes greater, and the accident is attended with greater violence of disruption, and more serious results follow. Where considerable portions of the boiler are weak, or long lines of weakness exist uninterrupted by points much more defective, disastrous explosions are very likely to take place with old boilers and at moderate pressures. The most terrible explosions occur with good and uniformly strong boilers, in which, by accident or mismanagement, steam has been allowed to accumulate until a fatally high pressure produces rupture and drives the fragments of the boiler in all directions. It has been shown by compiling the statistics of explosions, that the gradual accumulation of steam until a pressure is reached under which the weakest portion of the boiler gives way, is by far the most usual cause. Prof. Trowbridge has shown that the time of accumulation may be calculated by a formula, $T=\frac{W(t_1-t)}{Q}$, in which T is the time of accumulation, in minutes, from the pressure corresponding to the temperature $t$ to that of the temperature $t_1$ F.; W is the weight of water in the boiler, and Q the quantity of heat in British units transferred to the boiler per minute. He shows that T=9·1 minutes in a large marine boiler, containing 79,000 lbs. of water,

and with the pressure rising from 2½ to 4 atmospheres. In a locomotive boiler, he estimates the time required to raise the pressure from 90 lbs., the working point, to 175 lbs., the assumed exploding point, at 3½ minutes. A safety valve, of sufficient size and of good design, is the safeguard against such accidents, being so weighted that it will never allow the steam to rise above a pressure at which a proper "factor of safety" is given. Steam boilers should be designed with a factor of safety of at least 6 or 8, but they are frequently, even when new, capable of sustaining without rupture no more than four times the regular working pressure. As they deteriorate with age, the factor of safety is too generally allowed to decrease, until it becomes as small as legal requirements permit. This has usually been far too low in the United States, and frequently boilers are legally passed by the inspectors when their factors of safety are less than 1½. The accumulation of steam to an excessively high pressure is found to be most commonly due to defective pressure gauges, to entire deficiency of pressure indicators, and to the absence of or defects in safety valves. Boilers fail in consequence of deficiency of water, which, causing exposure of heating surfaces to the heated gases without protection, permits them to become overheated and weakened. Braces and straps are weakened by corrosion, and even entirely severed. Plates are cracked by changes of temperature and irregular expansion and contraction, or even burned as just described, and are blistered in consequence of defective manufacture. Deposits cover the heating surfaces, and, interposing a non-conducting coating between the metal and the water, permit overheating to take place even when the boiler is amply supplied with water. Corrosion produces extended and uniform weakening of sheets, or, forming grooves along the lines of junction of the plates, creates long lines of weakness. The sudden evolution of steam, in such volumes that the pressure is increased too rapidly to be effectively relieved by the safety valve or by the supply pipe leading to the engine, is considered by many authorities to be an occasional cause of explosion. This may be caused by the overheating of a portion of heating surface not in contact with the water (as when a deficiency of water occurs, or when the surface is heavily coated with scale), and a subsequent sudden return of the water into contact with the metal. The occurrence of the "spheroidal state" may, it is supposed, sometimes produce this effect when the liquid is restored to contact with the plate. (See BOILING POINT.) A committee of the Franklin institute in 1833-'6 experimented upon the first of the above named conditions, and found that very considerable accessions of pressure might be caused by the sudden return of the water upon overheated surfaces. The superheating of the water, as in experiments of Donny, Dufour, and others, is also supposed to be a possible cause of explosions. The United States government has appointed a commission to investigate this subject. They have produced many explosions by over pressure, by injecting feed water upon overheated iron in boilers, but have not yet (1876) made their report. It is generally supposed by engineers that good design, good materials and workmanship, and skilful and intelligent management, will almost invariably insure perfect immunity from danger of explosion; but the phenomena of sudden evolution of steam in steam boilers have not yet been fully investigated by any thoroughly scientific series of experimental researches. Steam boilers are usually tested at regular intervals. Careful and skilful inspection will almost invariably detect all serious defects. Every sheet should be examined to discover blisters, lamination, fracture, or corrosion. The use of a light hammer, tapping its surface and following the seams, will generally in practised hands reveal such defects and indicate their extent. All stays and braces should be carefully examined, and the boiler fittings, valves, and gauges should be inspected, and the last should be tested. After such an inspection and the repair of injured parts, it is considered by many engineers to be advisable to subject the boiler to a hydrostatic test. This consists in filling it with water, and raising the pressure to a point exceeding by one half or more the regular working pressure. This form of test is prescribed by the laws of the United States regulating steam-boiler management on steam vessels. (See BOILING POINT, EVAPORATION, HEAT, and VAPORIZATION.)—See N. Burgh, "Steam Boilers" (London, 1871); E. B. Martin, "Steam Boiler Explosions" (London, 1871); L. Delvordre, *Traité pratique sur les chaudières à vapeur* (Paris, 1872); Trowbridge, "Heat as a Source of Power" (New York, 1874); R. Wilson, "Treatise on Steam Boilers" (London, 1874); and J. Laurent, *Chaudières à vapeur* (Paris, 1875).

**STEAM CARRIAGE.** Road locomotives and traction engines have been frequently constructed for the transportation of both freight and passengers, and for hauling wagons carrying heavy loads. The latter application only has been permanently successful, although repeated attempts have been made to perfect steam carriages of high speed. As early as 1759 Dr. Robinson called the attention of Watt to the possibility of constructing a carriage to be driven by a steam engine. The first actual experiment was made, as is supposed, by a French army officer, Nicolas Joseph Cugnot, in 1769. Encouraged by the partial success of the first locomotive, he constructed a second in 1770, which is still preserved in the *conservatoire des arts et métiers*, Paris. Watt patented a road engine in 1784. About the same time his assistant, Murdoch, completed and made a trial of a model locomotive, driven by a "grasshopper engine," having a steam cylinder ¾ in. in diameter and 2 in.

stroke. It is said to have run 6 to 8 m. an hour. In 1786–'7 Oliver Evans obtained from the Pennsylvania legislature the monopoly of his method of applying the steam engine in driving flour mills, and from Maryland a similar privilege in regard to propelling wag-

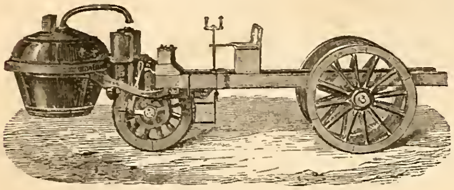


FIG. 1.—Cugnot's Steam Carriage, 1770.

ons. In the same or the following year William Symington constructed a working model of a steam carriage, which is now in the patent museum at South Kensington, London. In 1804 Oliver Evans completed a flat-bottomed boat to be used in dredging at the Philadelphia docks, and, mounting it on wheels, drove it by its own steam engine to the river bank. Launching the craft, he propelled it down the river, using its engine to drive its paddle wheels. Evans's "Oruktor Amphibolos," as he named the machine, was the first road locomotive that we find described after Cugnot's time. In 1821 Julius Griffiths of London made a steam carriage to carry passengers on common roads, which was probably the first ever constructed for that purpose only. During the succeeding 10 or 15 years, Messrs. Burstall and Hill and Bramah of London and Edinburgh, Sir Goldworthy Gurney, the Messrs. Seaward, Sir Charles Dance, W. H. James, Walter Hancock, Ogle and Summers, and others in Great Britain, and Harrison Dyar, Joseph Dixon, Rufus Porter, and Mr. James in the United States, attacked this problem with varying success. Sir Charles Dance made several hundred trips between London and Cheltenham in 1831. Hancock ran between London and Stratford, and Scott Russell from Glasgow to Paisley. From May to October, 1836, Han-

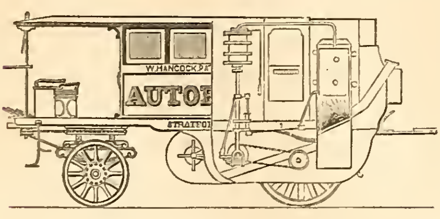


FIG. 2.—Hancock's Steam Carriage.

cock ran several carriages on the Paddington road. The general introduction of railroads, which took place immediately after the establishment of steam locomotion on the Liverpool and Manchester railway in 1829, put an end to what had promised to become an important and successful method of transportation of passengers and light merchandise. In December, 1833, more than 20 steam carriages were in use or under contract in and near London. It was proposed to substitute steam carriages, capable of travelling 12 or 15 m. an hour, for coaches drawn by horses on all mail routes. Hostile legislation procured by opposing interests, and the rapid progress of steam locomotion on railroads, caused an interruption of experiment, and almost nothing was done during the succeeding quarter of a century. It is only within a few years that any business has been founded upon the construction of road locomotives, although the scheme seems to have been at no time entirely given up. J. Scott Russell, Boydell, and a few others in England, and Messrs. Roper, Dudgeon, Fawkes, Latta, and J. K. Fisher, in the United States, have all labored in this direction. The last named engineer designed his first steam carriage in 1840, and was at work upon the problem till his death in 1873. A few firms have succeeded within a few years in making a business of constructing road locomotives for hauling heavy loads, and of building steam road roll-

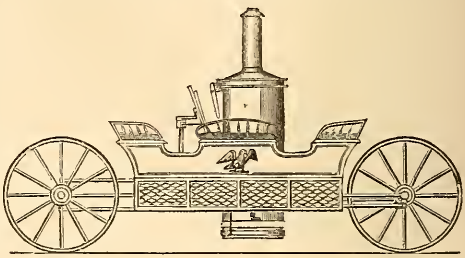


FIG. 3.—Fisher's Steam Carriage.

ers; but steam carriages of high speed, adapted to the transportation of passengers, have not yet been successfully introduced. The greatest impediments seem to be the roughness and bad construction of the ordinary highway, the frightening of horses, the engineering difficulties of construction, and the limited power of the machine as it has usually been built. The capabilities of the road locomotive are readily determined by experiment, and the following is an abstract of the results of several series of trials. A trial of a road engine was made by the well known French engineer H. Tresca, in presence of Prof. Fleeming Jenkin, and the report was submitted on Jan. 15, 1868. The results were as follows: 1. The coefficient of traction was about 0·25 on a good road with easy grades. 2. The consumption of coal was 4·4 lbs. per horse power per hour. 3. The consumption of water was 132·2 gallons an hour with the ten-horse engine. 4. The coefficient of adherence, or of friction between the wheels and the soil, was 0·3. 5. A speed of 7 m. an hour caused no special difficulty in managing either the locomotive or its load. About this

same time M. Servel conducted a series of experiments with a similar machine upon paved and upon macadamized roads, during what he described as the most trying of winter weather. He reports the following distribution of weight per cent.:

| | |
|---|---|
| Weight of locomotive | 41·4 |
| " of wagons | 18·2 |
| " of paying load | 40·4 |
| Total | 100 |

The average total weight of three loaded wagons, which was the usual load, was 22,575 kilogrammes, or about 22 tons. The experiment was made in 1867–'8 of applying these engines to the towage of boats on the French canals, with very encouraging results. In 1871 several traction engines were exhibited before the royal agricultural society of England at Wolverhampton, and the judges made a series of careful tests, reported in its "Journal" for that year. The coal used on special trial amounted to 3·2 lbs. per indicated horse power per hour, and the evaporation of water was 7·62 lbs. per pound of coal consumed, the average temperature of feed being 175° F. The load drawn up the maximum grade of 264 ft. to the mile on Tottenham hill, which is 1,900 ft. from top to bottom, was 26 tons, and including weight of engine 38 tons, giving a coefficient of traction of 0·35. On a country road 16 m. long it drew 15 tons at an average rate of 3½ m. an hour, using 2·85 lbs. of coal and 1·94 gallon of water per ton of useful load per mile. In October, 1871, Prof. R. H. Thurston conducted a public trial of road engines and steam road rollers, on a well macadamized road at South Orange, N. J. Two road steamers or traction engines and a steam road roller were tried. The following are the principal dimensions: weight of engine complete, 5 tons 4 cwt. (11,648 lbs.); diameter of steam cylinder, 7¾ in.; stroke of piston, 10 in.; revolutions of crank to one of driving wheel, 17; diameter of driving wheels, 60 in.; length of boiler over all, 8 ft.; diameter of boiler shell, 30 in.; load on driving wheels, 4 tons 10 cwt. (10,080 lbs.). The boiler was of the ordinary locomotive type, and the engine was mounted upon it, as is usual with portable engines. A representation of the engine is given in the article PLOUGH (fig. 10). The engine valve gear consisted of a three-ported valve and Stephenson link, with reversing lever, as generally used on locomotives. The connection between the gearing and the driving wheels was effected by the device called by builders of cotton machinery a Jack-in-the-box gear, or differential gear. By this combination, the effort exerted by the engine is made equal at both wheels at all times, even when the engine is turning a corner. The weight of the steam road roller was 15 tons. The engine and boiler were of the same general dimensions as in the road locomotives already described. The whole machine was carried on four large wheels, with broad tread, covering a total width of 6 ft. Its weight exerts a compressive force of 5,600 lbs. on each foot of width, or 467 lbs. on each inch. The following is a summary of the conclusions deduced from the trial, and published in the "Journal of the Franklin Institute:" A traction engine may be so constructed as to be easily and rapidly manœuvred on the common road; and an engine weighing over 5 tons may be turned continuously without difficulty on a circle of 18 ft. radius, or even on a road but little wider than the length of the engine. A locomotive of 5 tons 4 cwt. has been constructed, capable of drawing on a good road 23,000 lbs. up a grade of 533 ft. to the mile, at the rate of 4 m. an hour; and one might be constructed to draw more than 63,000 lbs. up a grade of 225 ft. to the mile, at the rate of 2 m. an hour. It was further shown that the coefficient of traction with heavily laden wagons on a good macadamized road is not far from $\frac{4}{100}$; the traction power of this engine is equal to that of 20 horses; the weight, exclusive of the weight of the engine, that could be drawn on a level road, was 163,452 lbs.; and the amount of fuel required is estimated at 500 lbs. a day. The advantages claimed for the traction engine over horse power are: no necessity for a limitation of working hours; a difference in first cost in favor of steam; and in heavy work on a common road the expense by steam is less than 25 per cent. of the average cost of horse power, a traction engine capable of doing the work of 25 horses being worked at as little expense as six or eight horses.—*Railroad Locomotives.* Steam carriages for use on railroads, or locomotives, came into public notice subsequently to the introduction of steam carriages on the common road, but they soon displaced the latter, and have now become the most usual means of transportation. In 1802 Trevithick, a Cornish miner, patented a high-pressure locomotive with a fly wheel on the crank shaft. Draught was secured by means of bellows. This little engine was so powerful that the inventor found the adhesion of the driving wheels to the rails insufficient, and proposed the use of gearing which should engage a rack laid down between the rails. Blenkinsop pursued Trevithick's plans, and made a locomotive which ran 10 m. an hour. Blackett in 1812 made a better distribution of weight, and obtained ample adhesion. John Stevens of Hoboken, N. J., in 1812 memorialized the legislature of the state of New York, urging the building of railways, and showing their advantages. He published a pamphlet in which he predicted that trains of carriages would be drawn on railways at 20 or 30 m. an hour, and that they might attain 40 or 50 m. an hour; and he further says: "I can see nothing to hinder a steam carriage from moving on these ways (rails) with a velocity of 100 m. an hour." Subsequently Stevens applied his steam boiler, patented in 1805, to a locomotive, which was

used however only experimentally. George Stephenson in 1814 introduced the locomotive in Great Britain. The steam blast of Hackworth, the tubular boiler of Séguin, and the link motion of Stephenson constitute the essential features of the modern locomotive. (See Railroad.) Locomotives have gradually and steadily increased in size and power from the date of their introduction. The Rocket, which first proved conclusively in 1829 the value of steam locomotion, weighed $4\frac{1}{4}$ tons. In 1835 Robert Stephenson, who had constructed it with his father, writing to Robert L. Stevens, said that he was making his engines heavier and heavier, and that the engine of which he enclosed a sketch weighed nine tons and could draw "100 tons at the rate of 16 m. an hour, on a level." Locomotives are now built weighing 70 tons, and powerful enough to draw more than 2,000 tons at a speed of 20 m. an hour. The modern locomotive consists of a boiler of the form shown in the article Steam Boiler, mounted upon a strong light frame of forged iron, by which it is connected with the wheels. The largest

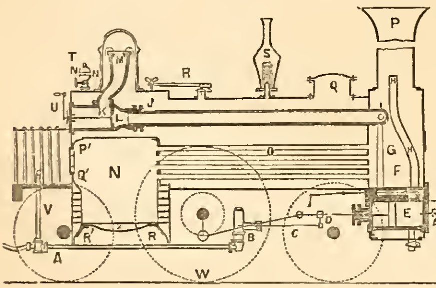


Fig. 4.—British Express Engine.

engine yet constructed in the United States is said to be one in use on the Philadelphia and Reading railroad, having a weight of about 100,000 lbs., which is carried on 12 driving wheels. A locomotive has two steam cylinders, either side by side within the frame, and immediately beneath the forward end of the boiler, or on each side and exterior to the frame. The engines are non-condensing and of the simplest possible construction. The whole machine is carried upon strong but flexible steel springs. The steam pressure is usually more than 100 lbs. The pulling power is generally about one fifth the weight under most favorable conditions, and becomes as low as one tenth on wet rails. The fuel employed is wood in new countries, coke in bituminous coal districts, and anthracite coal in the eastern part of the United States. The general arrangement and the proportions of locomotives differ somewhat in different localities. In fig. 4, a British express engine, O is the boiler, N the fire box, X the grate, G the smoke box, and P the chimney. S is a spring and R a lever safety valve, T is the whistle, L the throttle or regulator valve, E the steam cylinder, and W the driving wheel. The force pump, B C, is driven from the cross head, D. The frame is the base of the whole system, and all other parts are firmly secured to it. The boiler is made fast at one end, and provision is made for its expansion when heated. Adhesion is secured by throwing a proper proportion of the weight upon the driving wheel W. This is from about 6,000 lbs. on standard freight engines, having several pairs of drivers, to 10,000 lbs. on passenger engines, per axle. The peculiarities of the American type are the truck or bogie supporting the forward part of the engine, the system of equalizers, or beams which distribute the weight of the machine equally over the several axles, and minor differences of detail. The cab or house protecting the engine driver and fireman is an American device, which is gradually coming into use abroad also. The American locomotive is distinguished by its flexibility and ease of action upon even roughly laid roads. The cost of passenger locomotives of ordinary size is about \$12,000; heavier engines sometimes cost \$20,000. The locomotive is usually furnished with a tender, which carries its fuel and water. The standard passenger engine on the Pennsylvania railroad has four driving wheels, $5\frac{1}{2}$ ft. diameter; steam cylinders, 17 in. diameter and 2 ft. stroke; grate surface $15\frac{1}{2}$ sq. ft., and heating surface 1,058 sq. ft. It weighs 63,100 lbs., of which 39,000 lbs. are on the drivers and 24,100 on the truck. The shell of the boiler is $49\frac{1}{2}$ in. diameter and 20 ft. $2\frac{1}{2}$ in. long. The fire box is of steel, 6 ft. 2 in. long outside, $3\frac{1}{2}$ ft. wide, and 5 ft. 4 in. high. The tubes are of iron, 142 in number, $2\frac{1}{4}$ in. diameter, and 11 ft. 7 in. long. The steam dome is 30 in. outside diameter, the smoke stack $14\frac{1}{2}$ in. The feed water is supplied by one pump of 2 in. diameter and 2 ft. stroke, and by a No. 8 Giffard injector. The valves are $16\frac{1}{2}$ in. wide by $8\frac{1}{2}$ in. long, and have 5 in. travel. The steam ports are $15\frac{15}{16}$ in. wide and $1\frac{1}{4}$ in. long, and the exhaust port $15\frac{15}{16}$ by $2\frac{1}{2}$ in. The lap of the valve is, outside $\frac{3}{4}$ in., inside $\frac{1}{64}$ in. The eccentrics have a throw of $4\frac{1}{8}$ in. The freight engine has six driving wheels, $54\frac{5}{8}$ in. in diameter. The steam cylinders are 18 in. in diameter, stroke 22 in., grate surface 14.8 sq. ft., heating surface 1,096 ft. It weighs 68,500 lbs., of which 48,000 are on the drivers and 20,500 on the truck. The boiler is nearly of the same dimensions as that of the passenger engine, but the tubes are $2\frac{1}{2}$ in. in diameter, 12 ft. $9\frac{9}{16}$ in. long, and 119 in number. The stack is 18 in. in diameter. The pump is $2\frac{1}{4}$ in. in diameter, and has a stroke of 22 in. The valve has $\frac{3}{4}$ in. inside lap, $\frac{1}{16}$ in. outside. The former takes a train of five cars up an average grade of 90 ft. to the mile. The latter is attached to a train of 11 cars. On a grade of 50 ft. to the mile, the former takes 7 and the latter 17 cars. Tank engines for very heavy work, such as on grades of 320 ft. to the mile, which are found on some of the moun-

tain lines of road, are made with five pairs of driving wheels, and with no truck. The steam cylinders are 20½ in. in diameter, 2 ft. stroke; grate area, 15¾ ft.; heating surface, 1,380 ft.; weight with tank full, and full supply of wood, 112,000 lbs.; average weight, 108,000 lbs. Such an engine has hauled 110 tons up this grade at the speed of 5 m. an hour, the steam pressure being 145 lbs. The adhesion was about 23 per cent. of the weight. In checking a train in motion, the inertia of the engine itself absorbs a seriously large portion of the work of the brakes. This is sometimes reduced by reversing the engine and allowing the steam pressure to act in aid of the brakes. To avoid injury by abrasion of the surfaces of piston, cylinder, and the valves and valve seats, M. Le Chatelier introduces a jet of steam into the exhaust passages when reversing, and thus prevents the ingress of dust-laden air and the drying of the rubbing surfaces. The valve motion consists of the simplest forms of three-ported valve, moved by two eccentrics attached to a Stephenson link. In drawing a train weighing 150 tons at the rate of 60 m. an hour, about 800 effective horse power is required. A speed of 80 m. an hour has been attained several times. The locomotive engine has a maximum life which may be stated at about 30 years. The annual cost of repairs is from 10 to 15 per cent. of its first cost. On moderately level roads, the engine requires a pint of oil to each 25 m., and a ton of coal to each 40 or 50 m. run. (See RAILROAD.)—See Holley, "American and European Railway Practice" (New York, 1861); Weissenborn, "American Locomotive Engineering" (26 nos. 4to, plates 2 vols. fol., New York, 1861); Vose, "Manual for Railroad Engineers" (Boston, 1872); and Forney, "Catechism of the Locomotive" (New York, 1874).

**STEAM ENGINE.** Hero of Alexandria (about 250 B. C.) described, in his *Spiritalia* or *Pneumatica*, several insignificant contrivances illustrating the power of steam. The first modern reference to its actual or possible use is not definitely known. Blasco de Garay is believed by Spanish writers to have applied steam to the propulsion of a ship at Barcelona, A. D. 1543. Giambattista della Porta, in his *Spiritalia* (1601), described his apparatus for raising water by filling a vertical tube by condensing steam within it and then forcing the water upward by pressure. Salomon de Caus, engineer and architect to Louis XIII., in *Les raisons des forces mouvantes, avec diverses machines tant utiles que plaisantes* (1615), says that "water will, by the aid of fire, mount higher than its level," and describes a globe filled with water, and an attached vertical pipe through which the water was elevated by the expansion of steam generated by heating the vessel. Giovanni Branca published at Rome in 1629 an account of a mechanical application of a steam jet to the impulsion of a wheel against the vanes of which the jet impinged, and proposed its application to many useful purposes. The marquis of Worcester, in his "Century of Inventions" (1663), described an apparatus consisting of steam boilers worked alternately and of pipes conveying steam from them to a vessel in which its pressure operated to force water upward as suggested by De Caus. This was set up at Vauxhall, near London, and was the first instance of the application of steam to practical use. The separate boiler was the essential feature of this invention, and this is the basis of the claim that Worcester was one of the inventors of the steam engine. Sir Samuel Morland in 1683 constructed these engines commercially, and with an intelligent understanding of their principles and of the more important properties of steam. Denis Papin, of Blois, about 1690 invented an engine having a piston which separated the steam from the water in the cylinder, receiving steam from the boiler in Worcester's combination. He also invented the lever safety valve. Thomas Savery patented, July 25, 1698, a machine consisting of a duplicate set of boilers, steam reservoirs, and forcing tubes, which were worked alternately, and applied it extensively to the drainage of mines, and occasionally to raising water to turn mill wheels. Savery recharged his reservoirs by the use of surface condensation, and his apparatus was capable of working an indefinite period without stopping. Desaguliers in 1716 improved upon it by applying the Papin safety valve, and by using jet instead of surface condensation. This engine elevated 5,000,000 lbs. of water one foot with each hundred weight of coal consumed; it gave a "duty" therefore of 5,000,000. Thomas Newcomen, John Cawley, and Savery patented in 1705 the first steam engine really deserving the name. It consisted of a cylinder containing a piston driven upward by steam from a separate boiler, and forced downward by atmospheric pressure when the steam below the piston was removed by condensation. The engine was used only for pumping, the pump rod and piston rods being attached to opposite ends of a beam, as in modern engines. Steam was first condensed by the application of cold water to the exterior, as in the original Savery engine, but soon after a jet within the cylinder was used. The boiler was supplied with gauge cocks to indicate the height of water, and a safety valve. Humphrey Potter, an ingenious boy mechanic, in 1713 made the valve gear automatic by leading cords from the beam. Henry Beighton in 1718 substituted for the latter the plug rod and more substantial ap-

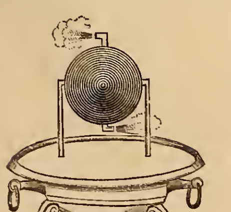


FIG. 1.—Hero's Steam Engine.

paratus still known to engineers. The improved Newcomen engine came into use during the 18th century throughout Europe. Brindley and John Smeaton devised some improvements in detail and proportion, and the latter built large engines of this type, attaining a duty of 9,500,000. Smeaton says that he had seen engines with cylinders 75 in. in diameter. His largest was 72 in., and its power that of 150 horses "acting together." James Watt, an instrument maker at the university of Glasgow, when repairing a model Newcomen engine (fig. 2) in 1763, began a series of improvements which finally rendered the steam engine universally applicable. To avoid losses of heat in the steam cylinder, which he estimated to amount to three fourths of all supplied, he attached (1765) the separate condenser, thus saving also three fourths of the injection water needed in the Newcomen engine. He first tried surface condensa-

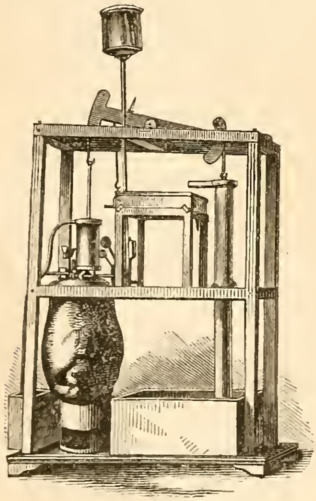


FIG. 2.—Newcomen Engine Model.

tion, but soon adopted the jet condenser and air pump. The piston had previously been kept from leaking by flooding it from above with water. Watt substituted oil and tallow. He closed the top with a cylinder head, passing the piston rod through a "stuffing box" to prevent leakage about it, and admitting steam above the piston, instead of air, during the down stroke, thus avoiding the cooling effect of the atmosphere. He then protected the cylinder by non-conducting coverings to intercept the heat previously lost by radiation from its exterior, and applied the "steam jacket," introducing a space intermediate between the cylinder and the external covering, in which space steam was retained. He thus converted the atmospheric steam engine of Newcomen into the type known as the engine of Watt. The firm of Boulton and Watt began building these engines at Soho, near Birmingham, in 1775. Watt proposed to secure economy of steam by its expansion in 1769, and in 1776 he adopted a form of cut-off which was patented in 1782. His later pumping engines attained a duty of 20,000,000. The crank and fly wheel were patented by Wasborough in 1781, and Watt adopted the "sun and planet wheels" as the next best expedient for obtaining rotary motion, and applied them in his double-acting engine patented July 4, 1782. This engine is shown in fig. 3, with the parallel motion, governor, and other details patented in 1784. Admitting steam and condensing on both sides of the piston, the power of the engine was doubled. Jonathan Hornblower in 1781 patented a compound or double cylinder engine, in which the steam used at high pressure in one cylinder was exhausted into a second, whence, after acting expansively and with reduced pressure, it was discharged. Woolf in 1804 patented the combination of this engine with the Watt condenser, and a few such engines were built. Oliver Evans devised in 1779 the high-pressure non-condensing steam engine. He introduced it into saw and grain mills, and applied it to the propulsion of vessels and locomotives. It still remains the most commonly used of all forms of the steam engine. Trevithick and Vivian introduced engines built on Evans's plan into Great Britain in 1802, which carried occasionally 60 to 80 lbs. of steam pressure. Col. John Stevens of Hoboken, N. J., built the direct-acting, high-pressure, and condensing engine, with a sectional steam boiler, in 1804. Joseph Dixon coupled two engines with cranks at right angles in 1823. The detachable, adjustable, or drop cut-off valve gear was patented by Frederick E. Sickels of New York in 1842, and the application of the governor to determine the point of cut-off was made by Zachariah Allen and George H. Corliss of Rhode Island, and patented by the latter in 1849. This completed the growth in general design of the now distinctive American expansive steam engine. Recently the revival of the double cylinder engine, with high steam, considerable expansion, and rapid motion of piston, which have proved economically successful, has been the only marked feature of this branch of engineering progress. It is estimated that the total steam power of the world is about 15,000,000 horse power, and that were horses actually employed to do the work which these engines would be capable of doing were they kept constantly in operation, the number required would exceed 60,000,000.—*Form of the Steam Engine.* In all engines the principal organs of the machine are present, but their forms and proportions, and their arrangement, differ greatly in different classes. In general, the piston, P, fig. 3, is accurately fitted into a steam cylinder, C, within which it moves from end to end with slight friction, and without permitting the escape of steam past its edges. The piston rod is attached at one end to this piston, and, passing through the cylinder head,

is attached at the other extremity to a cross head, which is so guided that it is compelled to move in a vertical line, and thus a side strain upon the rod which would produce friction and leakage, even were it not to cause actual bending and fracture, is prevented. In fig. 3 the

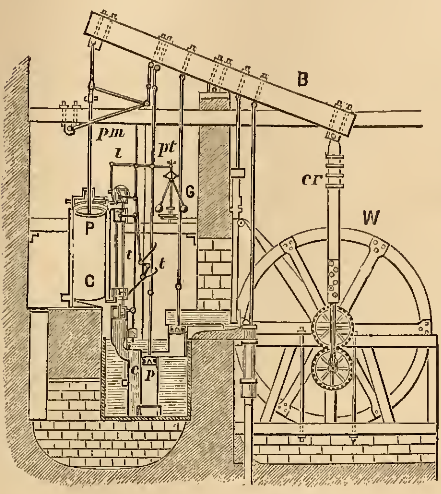



Fig. 3.—Watt's Engine, 1784.

cross head is guided by a parallel motion *p m*, an arrangement of rods of which one set vibrate about centres, thus displacing the centres of vibration of the other set just sufficiently to compensate the tendency of the latter to throw the cross head out of line by their sweep through their own curved path. This compensation permits the head of the piston rod to be securely guided in the vertical line. In later practice, a more common method of obtaining a rectilinear motion of the cross head is to place guides at each end of it, by which its extremities are kept in the desired line of motion. The sliding friction of the cross-head gibs upon these guides is slight, and is kept within proper limits by lubrication. The cross head is connected with the working beam, B, by links (usually a pair), and the beam, vibrating about the main centre, transfers the motion by means of the connecting rod, *c r*, to the crank attached to the main shaft or crank shaft, which carries the fly wheel or balance wheel, W. In this figure the crank is not shown, the sun and planet wheels taking its place. Steam is conveyed to the engine by the steam pipe, at some convenient point in which a stop valve is usually placed. Sometimes this valve is omitted, a throttle valve alone being used, adapted to adjust the supply of steam. The latter is either a disk valve, adjusted by a screw (in which form it is known as a screw stop valve), or it is some variety of slide valve, opening and closing by sliding transversely across the opening through which steam passes. Where the supply of steam is determined automatically, a governor, G, is attached, which when the speed of the engine tends to exceed the desired maximum closes the throttle valve, and when the speed falls too low opens it. In the figure, the governor consists of a pair of suspended balls caused to revolve by a belt, or by gearing connecting the spindle with the shaft, which when speed rises are given a high velocity of revolution about the spindle carrying them, and, separating under the action of centrifugal force, move the lever *l*, and thus close the throttle valve. There are many varieties of governors. The "fly-ball governor," just described, is most common, but, though simple and quite well adapted to general purposes, it is not perfectly isochronous; *i. e.*, it does not compel the engine to keep the precise speed at which it is set to work. As the governor and valve are rigidly connected, there is but one speed to which the position of the valve and of the governor can be perfectly adapted under any one set of conditions of steam pressure and of load. The valve gear is the system of valves and of actuating mechanism which distribute the steam as the engine passes through its cycles of motion. The steam valves admit steam alternately to each end of the steam cylinder, as the piston moves backward and forward, and the exhaust valves alternately open and close the passages or ports through which the steam escapes, after impelling the piston, into the condenser *c* in the condensing engine, or into the open air from a non-condensing engine. These valves are moved automatically by some part of the engine itself. In the kind of engine shown in fig. 3, and in pumping engines which have no crank and revolving shaft, the motion is obtained from a rod depending from the beam, projections on which rod strike the tappets *t* as they rise and fall. This rod is called the plug rod. In nearly all other engines, the valve gear is actuated by an eccentric, or disk attached to and revolving with the crank shaft. While the piston is moving upward, the steam valve below and the exhaust valve above are open, the steam entering below to drive the piston up, while the steam which had produced the downward stroke escapes through the open exhaust valve at the top into the condenser. During the descent of the piston these conditions are reversed. The condenser may be either a jet condenser, as shown in the figure, or a surface condenser. Its office is to condense the steam ejected from the cylinder, and thus to create a vacuum, so removing the resisting pressure of the atmosphere from before the piston. With the jet condenser, the steam issuing from the exhaust pipe of the engine is received in a closed vessel, where it is brought into contact with jets of cold water, and thus instantly condensed, and the vacuum so produced pervades the condenser, the exhaust pipe, and the exhausted end of the cylinder. The water of condensation, the re-

maining uncondensed vapor, and any air which may enter the condenser with the steam, are removed by the air pump *p*, and thrown into the hot well above the condenser whence they are taken by the hot water pump and discharged. Water is also taken from the hot well by the feed pump and fed to the steam boiler. —*Classification of Engines.* Steam engines are designated as condensing or non-condensing, according as they are furnished with a condenser or as that detail is omitted. They are high pressure or low pressure, the former term being applied to engines supplied with steam of 50 lbs. pressure to the square inch and upward, and the latter to engines working under 40 lbs. pressure. The latter are almost invariably condensing engines, and high-pressure engines are very generally non-condensing. Reciprocating engines have pistons moving backward and forward in the steam cylinder, as in Watt's engine. When they turn a shaft, they are sometimes called rotative. Rotary engines have a piston attached to a shaft and revolving with it within a cylinder of which the axis is parallel with the axis of rotation of the piston or vane. Engines are direct-acting where the piston rod acts directly upon the connecting rod, and through it upon the crank, without the intervention of a beam or lever. In back-acting or return connecting rod engines, the shaft lies between the cylinder and the cross head, the connecting rod returning from the cross head to the crank. Beam engines have the working beam already described. Side lever engines have two beams, one on each side of the steam cylinder, and below instead of above the cross head. Oscillating engines have their piston rods attached directly to the crank pin, and as the crank revolves the cylinder oscillates upon trunnions, one on each side of it, through which the steam enters and leaves the steam chest. The valves are within the steam chest, oscillating with the cylinder. In these engines the mechanism actuating the valves is seldom perfectly satisfactory in its operation. In compound or double-cylinder engines, the steam enters first a high-pressure cylinder, and there usually expands from its initial pressure of from 60 to 100 lbs. down to a much lower density; it is then exhausted into a second steam cylinder, in which it expands still further while completing its work.—Engines are also classified, according to the use for which they are intended, as stationary, pumping, portable, locomotive, or marine engines. The locomotive engine is the simplest form. In it the condenser and the governor are dispensed with, and the valve and its gearing are the simplest possible. The portable engine is usually very similar to the locomotive, and, like the latter, is attached to its steam boiler. It is sometimes provided with a heater to warm the feed water sent into the boiler, and is frequently provided with a governor. It is usually mounted on wheels. Both the locomotive and the portable engine employ high steam pressure without condensation. In both of these forms of engine are secured to the fullest extent lightness and simplicity, and, where properly constructed, cheapness, durability, compactness, and fair efficiency. Draft is usually secured in both by the blast of the exhaust steam. Engines of this class have attained the remarkable economical result of a horse power developed with the expenditure of less than three pounds of coal per hour.—The oldest form of pumping engine still retained in use is the Cornish. In it the crank shaft and balance wheel are dispensed with, the end of the pump rod being attached directly to the end of the beam opposite the steam cylinder. Steam is first admitted above the piston, driving it rapidly downward and raising the pump rod. At an early point in the stroke the admission of steam is checked by the sudden closing of the induction valve, and the stroke is completed under the action of expanding steam assisted by the inertia of the heavy parts already in motion. The necessary weight and inertia is afforded in many cases, where the engine is applied to the pumping of deep mines, by the immensely long and heavy pump rods. Where this weight is too great it is counterbalanced, and where too small, weights are added. When the stroke is completed, the "equilibrium valve" is opened, and the steam passes from above to the space below the piston, and an equilibrium of pressure being thus produced, the pump rods descend, forcing the water from the pumps and raising the steam piston. The absence of the crank or other device which might determine absolutely the length of stroke compels a very careful adjustment of steam admission to the amount of load. Should the stroke be allowed to exceed the proper length, and should danger thus arise of the piston striking the cylinder heads, the movement is checked by buffer beams. The valve motion is actuated by a plug rod, as in Watt's engine. The regulation is effected by a "cataract," a kind of hydraulic governor, consisting of a plunger pump with a reservoir attached. The plunger is raised by the engine, and then automatically detached. It falls with greater or less rapidity, its velocity being determined by the size of the eduction orifice, which is adjustable by hand. When the plunger reaches the bottom of the pump barrel, it disengages a catch, a weight is allowed to act upon the steam valve, opening it, and the engine is caused to make a stroke. When the outlet of the cataract is nearly closed, the engine stands still a considerable time while the plunger is descending, and the strokes succeed each other at long intervals. When the opening is greater, the cataract acts more rapidly, and the engine works faster. This has been regarded until recently as the most economical of pumping engines, and it is still generally used in freeing mines of water, and in situations where existing heavy pump rods may be utilized in con-

tinuing the motion of the piston during that portion of its stroke which is performed after expansion has begun. The direct-acting steam pump is sometimes used as a pumping engine. (See PUMP.) The compound pumping engine has been recently adopted with great success.

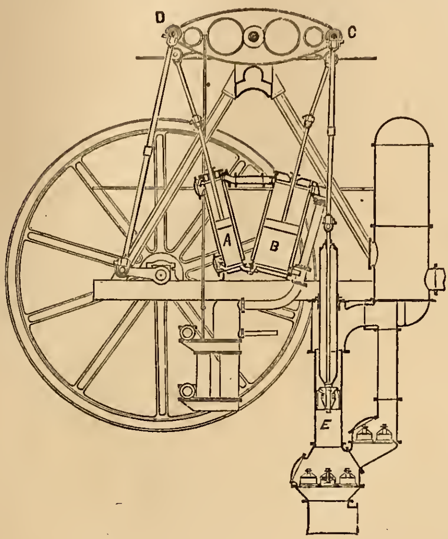


FIG. 4.—Leavitt's Pumping Engine.

One of the most efficient forms is that designed by E. D. Leavitt, jr., for the Lynn (Mass.) water works, and shown in fig. 4. The two cylinders, A and B, are placed one on each side the centre of the beam C D, and are so inclined that they may be coupled to opposite ends of it, while their lower ends are placed close together. At their upper ends a valve is placed at each end of the connecting steam pipe. At their lower ends a single valve serves as exhaust valve to the high-pressure and as steam valve to the low-pressure cylinder. The pistons move in opposite directions, and steam is exhausted from the high-pressure cylinder A directly into the nearer end of the low-pressure cylinder B. The pump, E, of the "Thames-Ditton" or "bucket and plunger" variety, takes a full supply of water on the down stroke, and discharges half when rising and half when descending again. The duty of this engine is reported by a board of engineers as 103,923,215 foot pounds for every 100 lbs. of coal burned. The duty of a moderately good engine is usually considered to be from 60 to 70 millions. This engine has steam cylinders of $17\frac{1}{2}$ and 36 in. diameter respectively, with a stroke of 7 ft. The pump had a capacity of about 195 gallons, and delivered 96 per cent. Steam was carried at a pressure of 75 lbs. above the atmosphere, and was expanded about ten times. Plain horizontal tubular boilers were used, evaporating 8·58 lbs. of water from 98° F. per pound of coal.—The stationary steam engine has a great variety of forms. Since compactness and lightness are not as essential as in portable, locomotive, and marine engines, the parts are arranged with a view simply to securing efficiency, and the design is determined by circumstances. It was formerly usual to adopt the condensing engine in mills and wherever a stationary engine was required. In Europe generally, and to some extent in the United States, where a supply of condensing water is obtainable, condensing engines and moderate steam pressures are still employed. But this engine is gradually becoming superseded by the high-pressure condensing engine, with considerable expansion, and with an expansion gear in which the point of cut-off is determined by the governor. The best known engine of this class is the Corliss engine, which is very extensively used in the United States, and which has been copied very generally by European builders. Fig. 5 represents the Corliss engine as built in the United States by Harris. The horizontal steam cylinder is bolted firmly to the end of the frame, which is so formed as to transmit the strain to the main journal with the greatest directness. The frame carries the guides for the cross head, which are both in the same vertical plane. The valves are four in number, a steam and an exhaust valve being placed at each end of the steam cylinder. Short steam passages are thus secured, and this diminution of clearance is a source of some economy. Both sets of valves are driven by an eccentric operating a disk or wrist plate, which vibrates on a pin projecting from the cylinder. Short links reaching from this wrist plate to the several valves move them with a peculiarly varying motion, opening and closing them rapidly, and moving them quite slowly when the port is either nearly open or almost closed. This effect is ingeniously secured by so placing the pins on the wrist plate that their

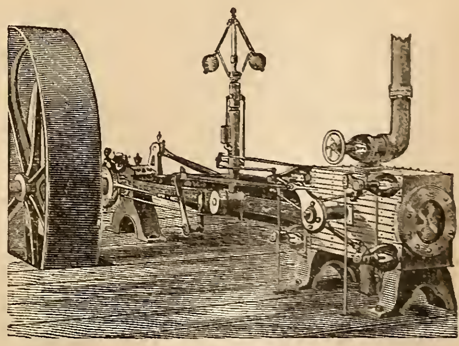


FIG. 5.—Corliss Engine.

line of motion becomes nearly transverse to the direction of the valve links when the limit of movement is approached. The links connecting the wrist plate with the arms moving the steam valves have catches at their extremities, which are disengaged by coming in con-

tact, as the arm swings around with the valve stem, with a cam adjusted by the governor. This adjustment permits the steam to follow the piston further when the engine is caused to "slow down," and thus tends to restore the proper speed. It disengages the steam valve earlier, and expands the steam to a greater extent, when the engine tends to run above the proper speed. When the catch is thrown out, the valve is closed by a weight or a strong spring. To prevent jar when the motion of the valve is checked, a "dash pot" is used, invented by F. E. Sickels. It is a vessel having a nicely fitted piston, which is received by a "cushion" of water or air when the piston suddenly enters the cylinder at the end of the valve movement. In the original water dash pot of Sickels, the cylinder is vertical, and the plunger or piston descends upon a small body of water confined in the base of the dash pot. In the Greene steam engine, fig. 6, the valves are four in number, as in the Corliss. The cut-off gear consists of a bar, A, moved by the steam eccentric in a direction parallel with the centre line of the cylinder and nearly coincident as to time with the piston. On this bar are tappets, C C, supported by springs and adjustable in height by the governor, G. These

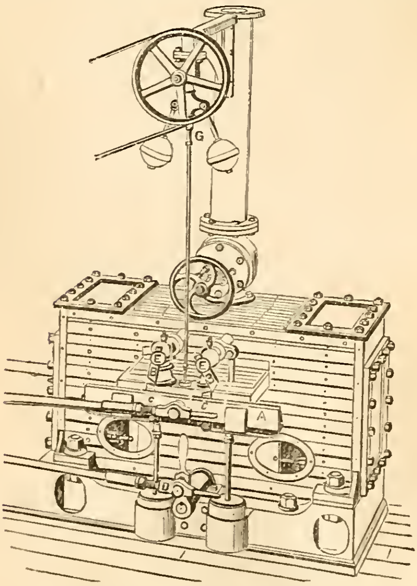



Fig. 6.—Greene Engine.

tappets engage the arms B B, on the ends of rock shafts E E, which move the steam valves and remain in contact with them a longer or shorter time, and opening the valve during a greater or less part of the piston stroke, as the governor permits the tappets to rise with diminishing engine speed, or forces them down as speed increases. The exhaust valves are moved by an independent eccentric rod, moved by an eccentric set, as is usual with the Corliss and with other engines generally, at right angles with the crank. This engine, in consequence of the independence of the steam eccentric, and of the contemporary movement of steam valve motion and steam piston, is capable of cutting off at any point from beginning to nearly the end of the stroke. The usual arrangement, by which steam and exhaust valves are moved by the same eccentric, only permits expansion with the range from the beginning to half stroke. The Wright engine has an adjustable expansion valve gear also, and the point of cut-off is determined by the governor. In this machine the steam valves are opened by a cam of such form that when the cam shaft is moved longitudinally, the valve is held open a longer or a shorter time. The position of the cam shaft is adjusted by the governor. Its motion is obtained by gearing it to the main shaft. The Babcock and Wilcox engine has a cut-off valve on the back of the main valve, which is moved by a small steam cylinder. The point of cut-off is determined by the governor also, by varying the time of admission of steam into the auxiliary cylinder. This engine has the same latitude of expansion as the Greene engine.—The characteristics of the American stationary engine are high steam pressure without condensation, an expansion valve gear with drop cut-off adjustable by the governor, high piston speed, and lightness combined with strength of construction. In other countries this engine is now rapidly coming into general use, but abroad the valve most generally adopted is the form usual in other styles of engine, expansion being obtained by a cut-off valve on the back of the main valve, and regulation secured by attaching the governor to a throttle valve.—*The Marine Steam Engine.* Marine engines have a great variety of forms, but general practice has now indicated a few which are preferred. They are almost invariably fitted with condensers. Until recently they were usually driven by steam of moderate pressure, but within a few years the pressure of steam, which in the time of Watt was usually from 5 to 10 lbs. above the atmosphere, has risen to 60 lbs. In the earlier days of steam navigation, the paddle wheel was exclusively used. Recently the screw has become the sole instrument of propulsion, where deep water permits its use. In shallow water the paddle wheel is still employed. Marine engines are therefore divided into paddle engines and screw engines. —The most common forms of paddle engines in the United States are the overhead beam engine, driven by steam of from 20 to 50 lbs. pressure, and fitted with a jet condenser, and the high-pressure and non-condensing direct-acting engine, used principally on the western rivers. The latter is driven by steam of from 100 to 150 lbs. pressure, and exhausts its steam into the atmosphere. It is the simplest possible form of direct-acting engine. The valves

are of the disk or poppet variety, rising and falling vertically. They are four in number, two steam and two exhaust valves being placed at each end of the steam cylinder. The beam engine is a peculiarly American type, seldom if ever seen abroad. Fig. 7 is an outline sketch of this engine as built for a steamer plying on the Hudson river. This class of engine is usually adopted in vessels of great length, light draught, and high speed. But one steam cylinder is commonly used. The cross head is coupled to one end of the beam by means of a pair of links, and the motion of the opposite end of the beam is transmitted to the crank by a connecting rod of moderate length. The beam has a cast-iron centre surrounded by a wrought-iron strap of lozenge shape, in which are forged the bosses for the end centres, or for the pins to which the connecting rod and the links are attached. The main centre of the beam is supported by a "gallows frame" of timbers so arranged as to receive all stresses longitudinally. The crank and shaft are of wrought iron. The valve gear is usually of

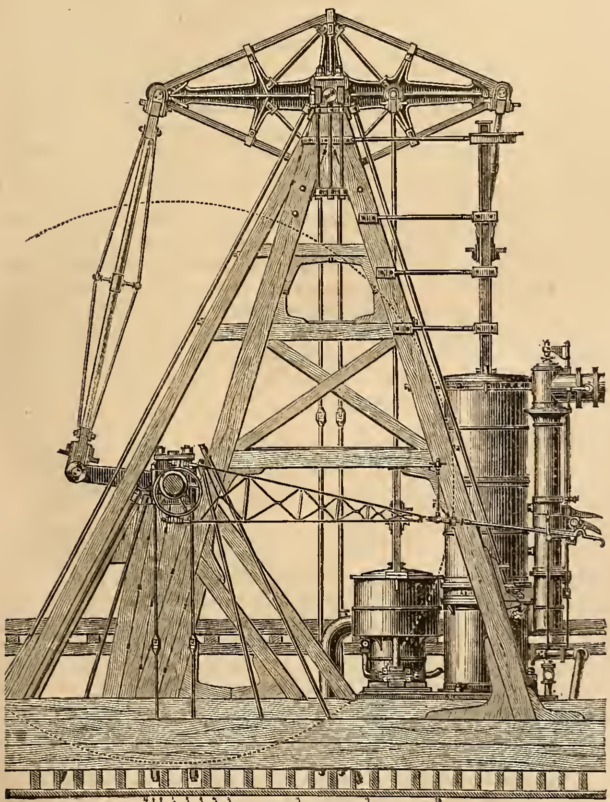


Fig. 7.—Beam Engine.

the form known as the Stevens valve gear an invention of Robert L. and Francis B. Stevens. The steam and exhaust valves are worked by independent eccentrics, the latter being set in the usual manner, opening and closing the exhaust passages just before the crank passes its centre. The steam eccentric is so placed that the steam valve is opened as usual, but closed when but about one half the stroke has been made. This result is accomplished by giving the eccentric a greater throw than is required by the motion of the valve, and permitting it to move through a portion of its path without moving the valve. Thus in fig. 8, if A B be the direction of motion of


Fig. 8.

the eccentric rod, the valve would ordinarily open the steam port when the eccentric assumes the position O C, closing when the eccentric has passed around to O D. With the Stevens valve gear, the valve is opened when the eccentric reaches O E, and closes when it arrives at O F. The steam valve of the opposite end of the cylinder is open while the eccentric is moving from O M to O K. Between K and E, and between F and M, both valves are seated. H B is proportional to the lift of the valve, and O H to the motion of the valve gear when out of contact with the valve lifters. While the crank is moving through an arc E F, steam is entering the cylinder; from F to M the steam is expanding. At M the stroke is completed and the other steam valve opens. The ratio $\frac{EO}{EM}$ is the ratio of expansion. The condenser is placed immediately beneath the steam cylinder. The air pump is placed close beside it, and worked by a rod attached to the beam. Steam vessels on the Hudson river have been driven by such engines at the rate of 23 m. an hour. This form of engine is remarkable for its smoothness of operation, its economy and durability, its compactness, and the latitude which it permits in the change of shape of the long flexible vessels in which it is generally used, without injury by "getting out of line." For paddle engines of large vessels, the favorite type has been the side lever engine, which is now rarely built. For smaller vessels, the oscillating engine with feathering paddle wheels is still largely employed in Europe. This style

of engine is shown in fig. 9. It is very compact, light, and moderately economical, and excels in simplicity. The feathering paddle wheel is made with floats or buckets variable in position, and so adjusted by the feathering mechanism that less power is expended in ob-

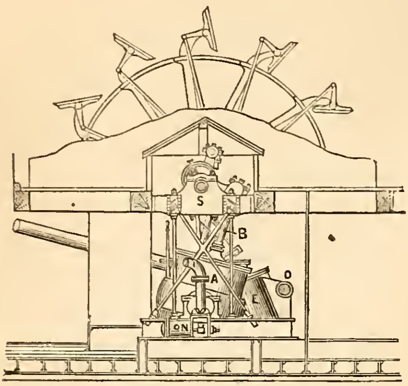



FIG. 9.—Oscillating Engine and feathering Paddle Wheel.

lique action, raising or pushing downward the water impinged upon, than with the ordinary radial wheel, in which the floats are rigidly attached to the arms. The usual arrangement is such that the feathering wheel has the same action upon the water as a radial wheel of double diameter. This reduction of the diameter of the wheel, while retaining maximum effectiveness, permits a high speed of engine, and therefore less weight, volume, and cost. The smaller wheel boxes, by offering less resistance to the wind, retard the progress of the vessel less than those of radial wheels. The feathering of the paddle is produced by the use of a rod, E D, fig. 10, which connects an eccentric strap, E F, secured to the vessel, with the short arm A D, by which the paddle is turned upon the pin A. C is the centre of the paddle wheel, and C B is one of the arms. Circular hoops, or bands, connect all of the arms, each of which carries a float. They are all thus tied together, forming a very firm and powerful combination to resist external forces. Inclined engines are sometimes used for driving paddle wheels. In these the steam cylinder lies in an inclined position, and its connecting rod directly connects the crank with the cross head. The condenser and air pump usually lie beneath the cross-head guides, and are worked by a bell crank driven by links on each side the connecting rod, attached to the cross head. Such engines are used to some extent in Europe, and they have been adopted in the United States navy for side-wheel gunboats. They are also used on the ferry boats plying between New York and Brooklyn. Paddle wheels should be immersed usually not more than one third the radius of the wheel for sea-going vessels, and on rivers they are frequently not immersed more than one sixth or one eighth. In the first case the loss by oblique action is about 5 per cent., in the last case about 10 per cent. A loss of 20 or 25 per cent. of the total power applied to the wheel is frequently caused by slip.—Many forms of engines have been used for driving the screw, but they are now almost invariably of one type. The ordinary screw engine is direct-acting. Two engines are placed side by side, with cranks on the shaft at an angle of 90 degrees with each other. In merchant steamers the steam cylinders are usually vertical and directly over the crank pins, to which the cross heads are coupled. The condenser is placed behind the engine frame, or, where a jet condenser is used, the frame itself is sometimes made hollow and serves as a condenser. The air pump is worked by a beam connected by links with the cross head. The general arrangement is like that shown in figs. 13 and 14. For naval purposes such a form is objectionable, since its height is so great that it would be exposed to injury by shot. In naval engineering the cylinder is placed horizontally, as in fig. 11, which is a sectional view, representing a horizontal, direct-acting naval screw engine, with jet condenser and double-acting air and circulating pumps. A is the steam cylinder, B the piston, which is connected to the crank pin by the piston rod D and connecting rod E. F is the cross-head guide. The eccentrics G operate the valve, which is of the "three-ported variety," by a Stephenson link.

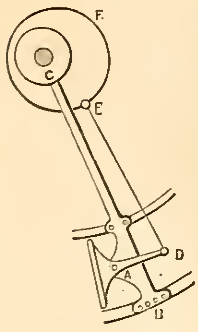



FIG. 10.

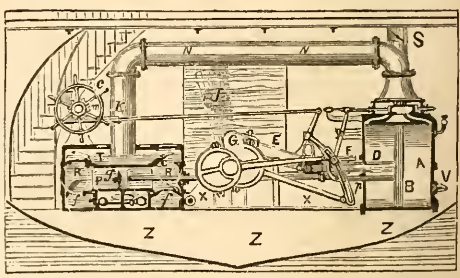



FIG. 11.—Horizontal direct-acting Naval Screw Engine.

Reversing is effected by the hand wheel C, which by means of a gear $m$ and a rack $k$ elevates and depresses the link, and thus reverses the valve. As shown in the sketch, this valve is so constructed that, when in precisely the middle of its path, it covers both steam ports as well as the exhaust port. When it is moved to the right, the forward steam port is opened

and the engine takes steam at the end D, while the steam from the opposite side of the piston, A, is allowed to pass out under the valve and off through the exhaust port. The valve is shown in this position in the figure. When the eccentric has turned with the shaft, or when the link is shifted so as to bring the end *p* into action and thus communicate the motion of the other eccentric to the valve, steam enters at the end A and is exhausted from D. Each eccentric produces this change in such a manner that when the piston reaches the end of its stroke this reversal occurs, and the steam and exhaust ports are opened and closed in the manner required to produce the proper distribution of steam. One eccentric is adjusted to give the correct distribution when the engine is moving ahead, the other when worked backward. When it is desired to produce a limited amount of expansion of steam, the exterior edges of the face of the valve are carried further apart, and the valve when in mid-position overlaps the steam ports. The throw of the eccentrics is then correspondingly increased, and they are moved upon the shaft until they can be secured in new positions in which they bring the edge of the valve to the edge of the port opening as before, admitting steam at the beginning of the stroke. By this process, which is termed giving lead to the valve, the exhaust port is also both opened and closed earlier than before. To remedy this fault, the edges of the interior of the valve are sometimes changed also, and they are given "lap" in either position, as on the steam side or negative. In the latter case they are moved further apart. Zeuner's valve diagram, fig. 12, is a useful graphic representation of the action of this valve. Let A B represent the path of the piston, A O, B O being the positions of the crank at each end of the stroke. Then E O, F O will be the positions of the crank when the

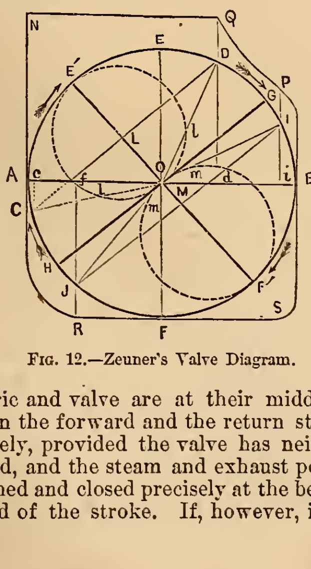
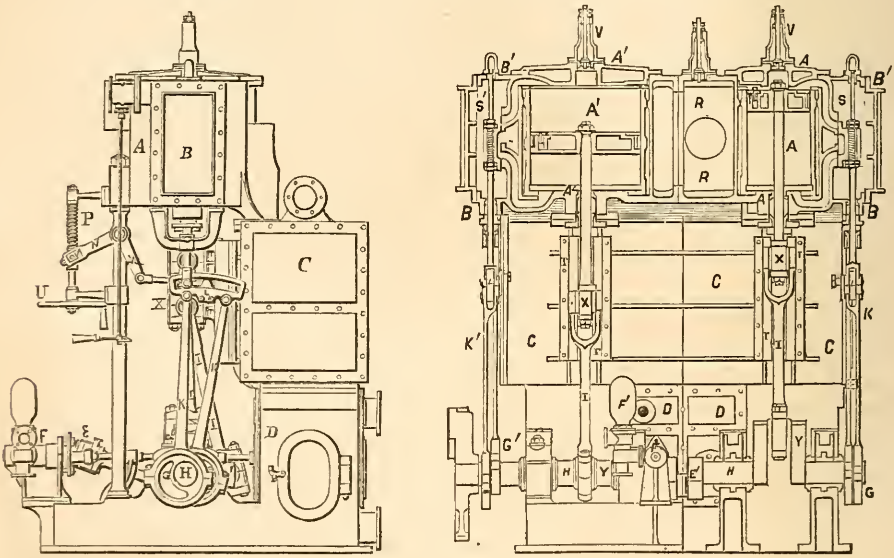



Fig. 12.—Zeuner's Valve Diagram.

eccentric and valve are at their middle positions on the forward and the return stroke respectively, provided the valve has neither lap nor lead, and the steam and exhaust ports will be opened and closed precisely at the beginning and end of the stroke. If, however, it is desired to open the steam port when the crank is at C and the piston at *c*, approaching A, and if the steam is to be cut off and expansion to begin when the crank is at D and the piston at *d*, on the forward stroke, the valve must be at "half throw" when the crank is at E′ midway between A and D. E′ O, F′ O will then be the positions of the crank when the valve is at mid throw on the forward and return stroke respectively. While the crank is moving from D to G the valve must continually cover the port which has remained open from A to D. The distances E′ L, L O are thus proportional to the motion of the valve while the port is opened and closed respectively, and $\frac{\mathrm{L\,O}}{\mathrm{E'\,O}}$ measures the lap. H O A is the "angular advance," or the distance by which the eccentric must precede its normal position E to insure the desired distribution of steam. A circle E *l* O being inscribed, the distance O *l* also measures the lap. Similarly, if the exhaust port is to be opened at I, it must close at J, and the steam is confined and "cushioned" behind the piston as the crank moves from J to A. O M or O *m* measures the "exhaust lap." The figure N Q P S R A N is the indicator diagram corresponding to such a distribution of steam, the steam pressure being maintained from N to Q, expansion occurring from Q to P, exhaust taking place at P, and S R being the line of back pressure on the return stroke. Cushioning takes place at R, and the steam being admitted immediately afterward, the pressure rises again to its maximum at N. This valve and gear only permits a very limited range of expansion in consequence of the seriously objectionable effect of the accompanying alteration of the exhaust. A separate expansion valve, moved by an independent eccentric, is usually placed between the steam pipe, S, fig. 11, and the main valve. The piston of the air pump, P, and the circulating pump, where a surface condenser is used, are driven by a rod *p* R from the main piston. The valves *f f* admit the water, and *c c* are the delivery valves. The pump is represented as just making a stroke from left to right. Steam is exhausted from the cylinder A through the exhaust pipe N N to the condenser, and when condensed falls to the bottom, whence the water of condensation is raised by the air pump and forced overboard through a delivery pipe and valve not shown. A portion of the stern of the vessel is represented as torn away to show the screw J. A strong and stiff main frame, X X, unites the cylinders with the condenser and also supports the main shaft journal at G. The whole is firmly secured by bolts to the cross floors of the vessel, Z Z, if of iron, or to engine keelsons if of wood. A spring water valve, V, is placed on the cylinder head to allow water which may enter the cylinder with the steam to be forced out without endangering the cylinder or the heads, as it might were

it caught there on the return of the piston. The trunk engine, in which the connecting rod is attached directly to the piston and vibrates within a trunk or cylinder secured to the piston, moving with it, and extending outside the cylinder, like an immense hollow piston rod, is frequently used in the British navy. It has rarely been adopted in the United States. —In nearly all steam vessels which have been built for the merchant service recently, and in some naval vessels, the compound engine has been adopted. Figs. 13 and 14 represent the usual form of this engine. Here A A, A′ A′ are the small and the large, or the high-pressure and the low-pressure cylinders respectively. B B′ are the valve chests. C C C is the condenser, which is invariably a surface condenser. The condensing water is sometimes directed around the tubes contained within the casing C C C, while the steam is exhausted around them and among them, and sometimes the steam is condensed within the tubes, while the injection water which is sent into the condenser to produce condensation passes around the exterior of the tubes. In either case, the tubes are usually of small diameter, varying from five eighths to half an inch, and in length from four to seven feet. The extent of heating surface is usually from one half to three fourths that of the heating surface of the boilers. The air and circulating pumps, D D, are placed on the lower part of the condenser casting, and are operated by a crank on the main shaft at E′; or they are sometimes placed as in the style of engine last described, and driven by a beam worked by the cross




Side Elevation. Front Elevation.

Figs. 13 and 14.—Compound Marine Engine.

head. The piston rods are guided by the cross heads X X working in slipper guides T T, and to these cross heads are attached the connecting rods I I, driving the cranks Y Y. The cranks are now usually set at right angles; in some engines this angle is increased to 120°, or even 180°. Where it is arranged as here shown, an intermediate reservoir, R R, is placed between the two cylinders to prevent the excessive variations of pressure that would otherwise accompany the varying relative motions of the pistons, as the steam passes from the high-pressure to the low-pressure cylinder. Steam from the boilers enters the high-pressure steam chest S, and is admitted by the steam valve alternately above and below the piston as usual. The exhaust steam is conducted through the exhaust passage around into the reservoir R, whence it is taken by the low-pressure cylinder, precisely as the smaller cylinder drew its steam from the boiler. From the large or low-pressure cylinder the steam is exhausted into the condenser. The valve gear is usually a Stephenson link, L, the position of which is determined, and the reversal of which is accomplished, by a hand wheel U and screw P, which, by the bell crank N M, are attached to the link L L.—*The Screw.* Screw steamers are far more efficient than paddle-wheel vessels, not only because the screw is a better instrument of propulsion, but because it permits the use of more efficient machinery, and especially because it utilizes a large amount of energy entirely wasted with the paddle wheel in putting in motion the water, which latter, coming into contact with the hull of the vessel, is set in motion by friction, and the following current is left behind to expend its *vis viva* by

contact with the surrounding mass of water. The currents so produced, in the case of screw vessels, impinge upon the screw, which works immediately astern of the vessel, and communicate to it a portion of that energy which would otherwise be lost in the creation of such currents. Screws work far below the surface of the water, and lose less by slip than the paddle wheel. Screw engines are quick-working, compact, and light. Their higher piston speed, their smaller size, and especially their more uniform action upon the propeller and the water, produce greater economy in the use of steam and a more effective application of power than is obtained with the paddle wheel. Incidentally, by permitting the replacing of a considerable weight of machinery and fuel by paying freight, they add greatly to the commercial value of the steam vessel. The forms of screws are exceedingly diverse, but those in common use are not numerous. In naval vessels it is common to apply screws of two blades, that they may be hoisted above water into a "well" when the vessel is under sail, or set with the two blades directly behind the stern post, when their resistance to the forward motion of the vessel will be comparatively small. In other vessels, and in the greater number of full-powered naval vessels, screws of three or four blades are used. The usual form of screw has blades of nearly equal breadth from the hub to the periphery, or slightly widening toward their extremities, as is seen in an exaggerated degree in fig. 15, representing the form adopted for tug-boats, where large surface near the extremity is more generally used than in vessels of high speed running free. In the Griffith screw, which has been much used, the hub is globular and very large. The blades are secured to the hub by flanges, and are bolted on in such a manner that their position may be

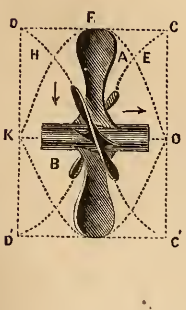



Fig. 15.—Tug-boat Screw.

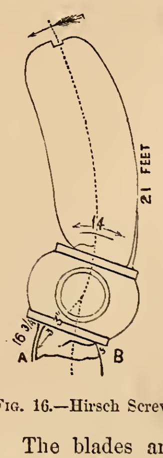



Fig. 16.—Hirsch Screw.

changed slightly if desired. The blades are shaped like the section of a pear, the wider part being nearest the hub, and the blades tapering rapidly toward their extremities. A usual form is intermediate between the last and that shown in fig. 15, the hub being sufficiently enlarged to permit the blades to be attached as in the Griffith screw, but more nearly cylindrical, and the blades having nearly uniform width from end to end. The Hirsch screw, fig. 16, is used on the steamship City of Peking. The pitch of a screw is the distance which would be traversed by the screw in one revolution were it to move through the water without slip; *i. e.*, it is double the distance C′ D, fig. 15. C D′ represents the helical path of the extremity of the blade B, and O E F H K is that of the blade A. The proportion of diameter C C′ to the pitch of the screw is determined by the speed of the vessel. For low speed the pitch may be as small as one and one fourth the diameter. For vessels of high speed the pitch is frequently double the diameter. The diameter of the screw is made as great as possible, since the slip decreases with the increase of the area of screw disk. Its length is usually about one sixth the diameter. A greater length produces loss by increase of surface causing too great friction, while a shorter screw does not fully utilize the resisting power of the cylinder of water within which it works, and increased slip causes waste of power. Negative slip occurs when the vessel moves at a higher speed than it would attain were the screw to work in a solid nut; it is sometimes observed in badly formed vessels. The slip is decreased by increasing the diameter, and also by increasing the length of the screw. The increased friction above referred to prevents the latter process from being economically carried beyond the maximum given. An empirical value for the probable slip in vessels of good shape, which is closely approximate usually, is given by Prof. Thurston as $S=4\frac{M}{A}$, in which S is the slip per cent., and M and A are the areas of the midship section and of the screw disk in square feet. The most effective screws have slightly greater pitch at the periphery than at the hub, and an increasing pitch from the forward to the rear part of the screw. The latter method of increasing pitch is more generally adopted alone. The thrust of the screw is the pressure which it exerts in driving the vessel forward. In well formed vessels, with good screws, about two thirds of the power applied to the screw is utilized in propulsion, the remainder being wasted in slip and other useless work. Its efficiency is in such a case, therefore, 66 per cent. Twin screws, one on each side of the stern post, are sometimes used in vessels of light draught and considerable breadth, whereby decreased slip is secured. The following are the dimensions of some of the largest marine screw engines of the well known types. The engines of the British iron-clad Monarch, a vessel of over 8,000 tons displacement, have given an "indicated power" of 8,528 horses at 65 revolutions a minute, when making a speed

of about 15 knots or $17\frac{1}{2}$ statute miles an hour. The steam pressure was 25 lbs. These engines are horizontal, and have steam cylinders 120 in. in diameter, and $4\frac{1}{2}$ ft. stroke of piston; the pistons weigh 8 tons each. The surface condensers contain 16,500 sq. ft. of condensing surface, the tubes being $\frac{5}{8}$ in. diameter, and 6 ft. long. The propelling power is a two-bladed Griffith screw, $23\frac{1}{3}$ ft. diameter, $26\frac{1}{3}$ ft. mean pitch, expanding 5 ft. The valves are moved by a link motion, of which the reversing gear is worked by a small steam reversing engine, which weighs about 350 tons; the boiler weighs nearly as much more. The cost of engines and boiler was £66,500. The City of Peking, a screw steamer built for the Pacific mail company, is a vessel of 5,000 tons. There are two pairs of compound engines, having cylinders of 51 and 88 in. diameter, and $4\frac{1}{2}$ ft. stroke of piston. The crank shafts are 18 in. in diameter. Steam is carried at 60 lbs., and is expanded nine times. The boilers are ten in number, cylindrical in form and with cylindrical flues; they are 13 ft. in diameter, $10\frac{1}{2}$ ft. long, with shells of iron $\frac{13}{16}$ in. thick, and have 520 ft. of grate surface, 16,500 sq. ft. of heating surface, and 1,600 sq. ft. of superheating surface. The smoke funnels, or stacks, are $8\frac{1}{2}$ ft. in diameter and 70 ft. high.—*Steam Pressure and Engine Power.* The steam in the engine exerts a varying pressure from the beginning to the end of the stroke, and these pressures may be determined experimentally by the use of the steam engine indicator. The best form now in general use is the Richards indicator, fig. 17. A miniature steam cylinder, A, has within it a closely fitted piston, which by exceedingly nice construction is made to work perfectly steam-tight without friction or leakage. Its rod B is attached to the parallel motion C D E F, which carries a pencil at the middle of F in a perfectly vertical line. To the upper side of this piston and to the cap V of the cylinder is screwed a helical steel spring, of such strength that, resisting the steam pressure beneath the piston, it causes the pencil to rise and fall, as pressures vary, through distances which are proportional to the changes of pressure. A scale, G, on the barrel H H, indicates the pressures per square inch which correspond with the position of the pencil at any instant. The barrel H H is connected by means of the string I with some part of the engine having a motion coincident in time with that of the steam piston, but of such extent that at each stroke of the engine the barrel H will be turned about three fourths of a revolution only. A piece of paper or thin card is wrapped upon this barrel, its end being secured by the springs W, and upon this paper the indicator card or diagram is automatically made by the pencil. The instrument is attached to the steam cylinder by the cock N, which is screwed at O into the cylinder in such a position that steam can at all times enter it, and so that the pressure in the engine and in the indicator shall be the same. The instrument is secured to the cock by the use of the nut with its double screw threads R S, one of which being finer than the other, the cone T may be forced into U very firmly, and perfectly steam-tight. An indicator should be attached to each end of the cylinder, and diagrams taken simultaneously if possible. The instrument being thus attached and steam admitted, after a few moments' working has thoroughly heated the cylinder, the steam is shut off from the indicator, and the pencil is, with its support J K, swung around, until it touches the paper. As the barrel revolves, the pencil makes a horizontal line, which is called the atmospheric line or line of atmospheric pressure. The reading of the barometer will then give the distance of the vacuum line, or the line of absolutely no pressure, below this line of reference. Steam is again admitted, and the pencil, rising and falling as the steam pressure changes in the cylinder, while the paper is moved laterally with a motion precisely similar to that of the piston, a diagram is made, usually resembling *b c d e f a* in fig. 18, taken from the work of Mr. Charles T. Porter on the indicator. Steam from the boiler is supplied to the engine at the commencement of the stroke nearly at boiler pressure, and follows the piston at that pressure until at *c* the steam passage is gradually contracted, and finally closed by the steam valve. The steam thus confined within the cylinder expands as the piston moves forward, diminishing in pressure until it arrives at *d*, where the exhaust valve gradually opens communication with the

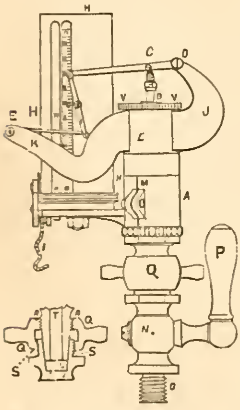


Fig. 17.—Richards Indicator.

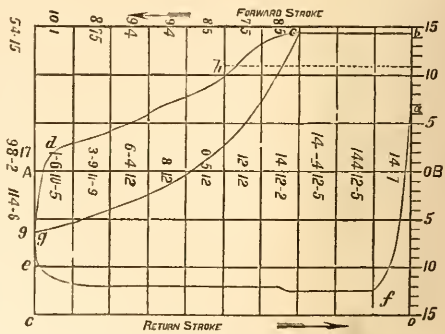


Fig. 18.—Diagram of Indicator.

condenser; the pressure drops to $e$ at the end of the stroke, and as condensation becomes completed during the return stroke, the minimum pressure is soon reached and retained until at $f$ the closing of the exhaust valve shuts up a small portion remaining in the cylinder, and it is compressed by the returning piston and its pressure thus increased to $a$, where the end of the return stroke is reached, the steam valve again opens, and a new cycle of operations begins. A B is the atmospheric line, and C D that of absolute vacuum. In consequence of the slow closing of the steam or cut-off valve in this case, the steam is not completely cut off until the point $h$ is reached, where the change in the character of the curve shows that only from $h$ to $d$ does the steam expansion line truly represent the law of change of volume with pressure. From $c$ to $h$ the steam "wire-draws" through the steam port, and the benefit of expansion is not fully secured. Were the steam port closed instantaneously at $c$, the line $c\,g$ would be the expansion line, and would closely correspond with that described already (see STEAM) for the special conditions under which it may have been formed. It is to secure this sudden closing and this full benefit of expansion that the drop cut-offs of Sickels, Corliss, Greene, and others have been adopted. Referring again to the diagram, should the "lead" be increased, and steam thus admitted earlier in the stroke, the line $a\,b$ would be formed parallel with but in advance of its present position. With less lead, the point $b$ would be moved also, the line $a\,b$ becoming inclined to the left. With a greater or less expansion, the point $e$ moves to the right or the left. With a rapidly closing cut-off valve, the curve $c\,h$ becomes shorter, and the curve $c\,h\,g$ more nearly like $c\,g$. A better vacuum would bring the line $e\,f$ nearer C D. In a non-condensing engine $e\,f$ would be above A B. The distance of $e\,f$ above A B or above C D indicates the back pressure produced by resistances in the exhaust passages, or the degree of imperfection of the vacuum which is due to the presence of both vapor and air in small quantity. With a three-ported valve, such as is used on locomotives, a shorter cut-off would cause an earlier closing of the exhaust on the return stroke, and the point $f$ would fall at the left of its present position. —The mean value of the steam pressure in the cylinder, as determined by measuring the altitude of the diagram at several points, or by obtaining its area with a planimeter and dividing by its length, is termed the mean pressure. The horse power is determined by multiplying the mean pressure by the area of piston and the speed of piston, and dividing by the value of a horse power. That is, HP $= \frac{P \times A \times V}{33000}$, where P is the mean pressure per square inch, A the area of piston in square inches, V the speed of piston or the product of the length of stroke in feet by twice the number of revolutions per minute. The horse power was assumed by James Watt as equivalent to 33,000 lbs. raised one foot high in a minute, 550 foot pounds a second, or 1,980,000 foot pounds of work an hour. This is about the maximum which the best London draught horses were then considered capable of performing. An average actual horse power is about 25,000 lbs. a minute, but Watt's figure is retained by engineers. With engines of ordinary proportions, the mean pressure may be determined with considerable accuracy also by the formula $p = P\,\frac{1 + A \log . E}{E} - B - CP$, the assumption being very nearly correct that steam expands in such cases according to Mariotte's law, the curve of pressure being a hyperbola and the product of pressure and volume constant. The values of the constants A, B, and C, as determined by Francis B. Stevens, are $A = 2{\cdot}3$, $B = 5$, and $C = 0{\cdot}06$. P is the initial pressure and $p$ the mean pressure. With engines working at moderate pressure, with unjacketed cylinders and medium speed of piston, the point of cut-off giving maximum economy is at about 0·4 or 0·5 the stroke. With high steam and rapid motion, and with steam-jacketed cylinders, economy is gained until the steam is expanded four to six times. In compound engines it is not unusual to expand from eight to twelve times, but experiment has not indicated that such great expansion is attended with economy. The losses which accompany great expansion are due to internal condensation of steam and its reëvaporation on the opening of the exhaust valve, when it carries away a large proportion of unutilized heat into the condenser. This loss sometimes exceeds the amount of heat actually utilized. In recent experiments the steam jacket has been found to save 20 per cent. by checking this condensation, which is the principal source of loss of economy in such engines. Superheating the steam sufficiently to cause it to pass through the cylinder "dry" diminishes it also. The minimum expenditure of steam in the best engines is about 16 or 18 lbs. per horse power per hour. The amount used in the single cylinder engine with moderate expansion and comparatively low pressure is seldom less than 30 lbs., and in old styles of engines worked with a pressure of 20 lbs. per square inch and cutting off at three fourths stroke, the consumption of fuel is often 6 lbs. and of steam 40 to 50 lbs. per horse power per hour. The expenditure of coal has been reduced by successive improvements, as the increase of steam pressure, greater expansion, surface condensation, high piston speed, the use of the steam jacket, and minor changes in both engine and boiler, until the best steam engines of the present day consume but about 2 lbs. of coal per horse power per hour, in ordinary work, and in some instances as little as 1½ lb. Even the latter, however, is but about one eighth the efficiency which would be given by a per-

fect heat engine.—See Tredgold, "Treatise on Steam Engines" (3 vols. 4to, London, 1852); Bourne, "Treatise on the Screw Propeller" (new ed., London, 1873), "Treatise on the Steam Engine" (new ed., 1873), "Handbook of the Steam Engine" (new ed., 1873), and "Examples of Modern Steam, Air, and Gas Engines" (4to, 1868 *et seq.*); Rankine, "Manual of the Steam Engine and other Prime Movers" (7th ed., London, 1874); and Clark, "Steam and Steam Engines" (London, 1875).

**STEAM HEATING.** See p. 894.

**STEAM NAVIGATION.** The origin of the paddle wheel for propelling vessels antedates the Christian era. The earliest application of steam to turn the paddle wheel was anticipated by Roger Bacon. The attempt of Blasco de Garay in 1543, if it was made as asserted, is the earliest on record. Papin is said to have experimented with his engine in a model boat in 1707, on the Fulda at Cassel. Jonathan Hulls patented a marine steam engine Dec. 21, 1736, proposing to employ his vessel in towing. He published a descriptive pamphlet in 1737, containing a sketch (fig. 1) of a Newcomen engine, with a system of counterpoises, ropes, ratchets, and grooved wheels, giving a continuous motion. William Henry of Chester co., Pa.,

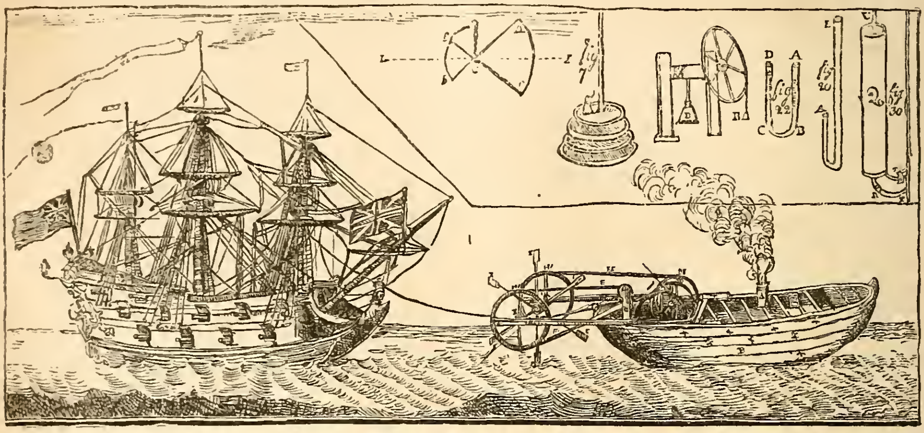


Fig. 1.—Hulls's Steamer, 1736.

tried a model steamboat on the Conestoga river in 1763. The count d'Auxiron, a French nobleman, assisted by M. Périer, made a similar attempt in 1774, and Périer repeated the experiment in 1775. The marquis de Jouffroy was engaged in the same work from 1776 to 1783, using a larger vessel and meeting with encouraging success. James Rumsey was engaged in experiments in the United States as early as 1784, and in 1786 drove a boat on the Potomac near Shepherdstown at the rate of 4 m. an hour by means of a water jet forced out at the stern. Rumsey subsequently went to England and continued his experiments on the Thames. (See Rumsey, James.) John Fitch worked at this problem at the same time with Rumsey, and had an experimental steamer on the Delaware in 1786. His propelling instruments were paddles suspended by the upper ends of their shafts and moved by a series of cranks. This boat (fig. 2) was 60 ft. long. Another vessel in 1790 made many trips on the Delaware, reaching an average speed of 7½ m. an hour. It was laid up in 1792. In 1796 Fitch resumed his experiments at New York, using a screw. (See Fitch, John.) In 1788 three Scotch gentlemen, Miller, Taylor, and Symington, obtained a speed of 5 m. an hour with a steamboat on Dalswinton loch. In this vessel two connected hulls were driven by a single paddle wheel placed between them and turned by a small engine. In 1789 a larger vessel, propelled by an engine of 12 horse power, attained a speed of 7 m. an hour. In 1801 Symington constructed for Lord Dundas a steamboat for towing on the canal, named the Charlotte Dundas, which was used successfully in 1802. It had a stern wheel driven by an engine, 22 in. in diameter of cylinder and of 4 ft. stroke. It drew vessels of 140 tons burden 3½ m. an hour, but was laid up soon afterward in consequence of a fear that the banks of the canal might be seriously injured

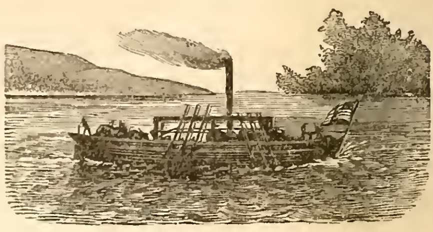


Fig. 2.—Fitch's Steamboat, 1786.

by the waves. Robert Fulton, an American artist, and subsequently a civil engineer, built a steamboat on the Seine in 1803, assisted by

Chancellor R. Livingston. (See FULTON, ROBERT.) Fulton had known William Henry in the United States, and seems to have been familiar with the work of contemporary in-

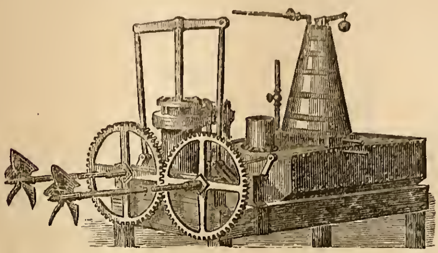


FIG. 3.—Col. John Stevens's Steam Engine, Boiler, and Screws, 1804.

ventors, and he had visited England, where he found others at work upon the same problem. In 1804 Col. John Stevens experimented with encouraging success with a small vessel driven by a high-pressure engine, a sectional boiler, and a single screw. He also tried twin screws, the steamboat having a length of 68 ft. and a breadth of 14 ft. This machinery (fig. 3) is retained in a good state of preservation at the Stevens institute of technology, Hoboken, N. J. Placed in a new hull on the Hudson in 1844, this engine produced a speed of 8 m. an hour. The experiments of Oliver Evans have been mentioned under STEAM CARRIAGE. Fulton, after studying the subject abroad, returned to the United States in 1806, and with Livingston had a boat built in which he placed machinery made by Boulton and Watt in England. The craft was 130 ft. long, of 18 ft. beam, 7 ft. depth, and 160 tons burden. The hull was built by Charles Brown of New York. The engine had

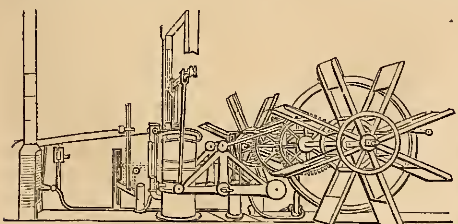


FIG. 4.—Engine of the Clermont, 1807.

a steam cylinder 24 in. in diameter and a stroke of 4 ft. The boiler was 20 ft. long, 7 ft. deep, and 8 ft. wide. The wheels were 15 ft. in diameter, with floats of 4 ft. length and 2 ft. dip. This steamboat, the Clermont, made a successful trip to Albany in 1807, leaving New York at 1 o'clock P. M. on Monday, Aug. 7, stopping at Livingston Manor (Clermont) from 1 o'clock Tuesday until 9 A. M. Wednesday, and reaching Albany at 5 P. M. on that day. The average speed was nearly 5 m. an hour. The return trip, on Thursday and Friday, occupied 30 hours, the rate of speed being 5 m. an hour. The Clermont, lengthened 10 ft., and with machinery slightly altered, made regular trips to Albany in 1808, and was the first steamboat ever made commercially successful. Almost simultaneously with Fulton's Clermont, Stevens brought out the Phœnix, a side-wheel steamer having hollow water lines; in the following year it was provided with feathering paddle wheels. This steamer could not ply on the Hudson, as Fulton and Livingston held a monopoly of the navigation of that river, and the Phœnix was taken by sea around to the Delaware river. This was the first sea voyage ever made by a steam vessel. From this time the steamboat was rapidly introduced. Fulton with his coadjutors placed a fleet upon the Hudson river and Long Island sound, and Stevens worked with his sons upon the Delaware and the Connecticut, and finally in the waters of New York also. In 1811 Fulton and Livingston began building steamers at Pittsburgh. In 1812 the Comet, built by Henry Bell, inaugurated regular steam navigation on the river Clyde in Scotland. This steamboat was 40 ft. long, 10½ ft. wide, and of 25 tons burden. The engines, of three horse power, drove two pairs of paddle wheels. The speed attained was about 5 m. an hour. In 1825 James P. Allaire of New York built compound engines for the Henry Eckford, and subsequently constructed similar engines for several other steamers, of which the Sun made the trip from New York to Albany in 12 hours 18 minutes. Soon afterward Erastus W. Smith introduced this form of engine on the great lakes, and still later they were introduced into British steamers. The machinery of the steamer Buckeye State was constructed at the Allaire works, New York, in 1850, from the designs of John Baird and Erastus W. Smith, the latter being the designing and constructing engineer. The steamer was placed on the route between Buffalo, Cleveland, and Detroit in 1851, and gave most satisfactory results, consuming less than two thirds the fuel required by a similar vessel of the same line fitted with the single-cylinder engine. The steam cylinders of this engine were placed one within the other, the low-pressure exterior cylinder being annular. They were 37 and 80 in. in diameter respectively, and the stroke was 11 ft. Both pistons were connected to one cross head, and the general arrangement of the engine was similar to that of the common form of beam engine. The steam pressure was from 70 to 75 lbs., about the maximum pressure adopted a quarter of a century later on transatlantic lines. This steamer was of high speed as well as economical of fuel.—Ocean navigation by steam, begun by Stevens in 1808, was made an assured success by the voyage of the Savannah in 1819, from Savannah, Ga., to Russia *via* England. In this vessel both sails and steam were used. She returned to New York, direct from St. Petersburg, in 26 days. Between 1821 and 1825 John Babcock, Robert L. Thurston, and Capt. Northup

ran steamers from Newport, R. I., to Providence and to New York. In 1825 the steamer Enterprise went to Calcutta from England, and in 1836 it was proposed to establish lines of steam vessels between New York and Liverpool. In 1838 the Sirius, a ship of 700 tons and 250 horse power, sailed from Cork, April 4; and the Great Western, a comparatively powerful steamer of 1,340 tons, 236 ft. in length, with engines of 450 horse power, paddle wheels 28 ft. diameter and 10 ft. length of floats, sailed from Bristol April 8. Both vessels arrived at New York April 23, the Sirius in the morning and the Great Western in the afternoon. At this time Ericsson, Smith, and others were again experimenting with the screw, and Ericsson soon brought it into general use in the United States. His first boat was successful as a tugboat on the Thames in 1837. (See STEAM ENGINE.) The first naval screw vessel, the Archimedes, built for the British navy in 1840, was so perfectly successful that comparatively few paddle steamers were subsequently built. The earliest regular transatlantic line of steamers, the Cunard line, sent its first vessel, the Britannia, of 1,350 tons, from Liverpool, July 4, 1840. In 1847 Capt. R. B. Forbes took out the first transatlantic screw steamer, the Massachusetts, and introduced steam vessels into Chinese waters, sending out hulls and machinery from the United States in sailing vessels.—Attempts have been made within a few years to revive the system of hydraulic propulsion first tried a century ago by Rumsey. Chain propulsion has in some instances proved very satisfactory. A chain or wire rope is laid in the bed of the river, or along the proposed route of the steamer, and passes over a drum worked by steam engines on the vessel, which is hauled along, taking in the chain at the bow and passing it out astern. In this arrangement loss by slip or oblique action is avoided, and a very satisfactory degree of economy is attained. Here, however, but little lateral movement of the vessel is permitted, and only one vessel can make use of the chain.—The most successful steam vessels in general use are the screw steamers of transoceanic lines. These are from 350 to 450 ft. long, usually propelled from 12 to 15 knots (14 to 17½ m.) an hour, by engines of from 3,000 to 4,000 horse power, consuming from 70 to 100 tons of coal a day, and crossing the Atlantic in from 8 to 10 days. These vessels are now invariably fitted with the compound engine and surface condensers. The largest vessel yet constructed is the Great Eastern, fig. 5, begun in 1854 and completed in 1859, by J. Scott Russell, on the Thames, England. This ship is 680 ft. long, 83 ft. wide, 58 ft. deep, 28 ft. draught, and of 24,000 tons measurement. There are four paddle and four screw engines, the former having steam cylinders 74 in. in diameter with 14 ft. stroke, the latter 84 in. in diameter and 4 ft. stroke. They are collectively of 10,000 actual horse power. The paddle wheels are 56 ft. in diameter, the screw 24 ft. The steam boilers supplying the paddle engines have 44,000 sq. ft. (more than an acre) of heating surface. The boilers supplying the screw engines are still larger. At 30 ft. draught this great vessel displaces 27,000 tons. The engines were designed to develop 10,000 horse power, driving the ship at the rate of 16½ statute miles an hour.

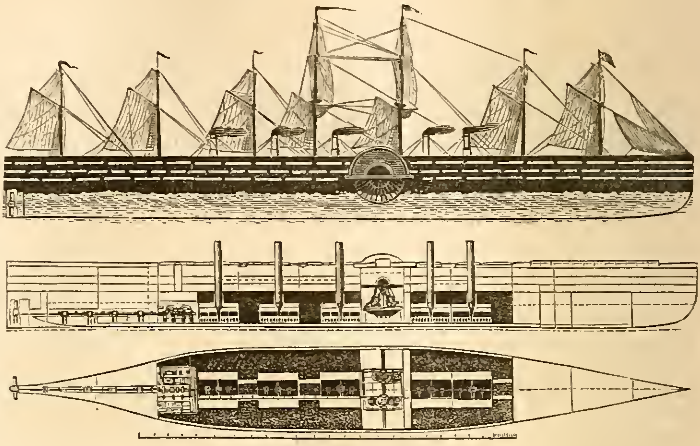


FIG. 5.—Great Eastern.

**STEARIC ACID** (Gr. *στέαρ*, tallow), a fatty acid obtained from mutton suet, and other fats that contain stearine, by saponifying suet and decomposing the hot solution of the soap with hydrochloric, or still better with tartaric acid. The oily acids are next submitted to pressure between hot plates, by which means a large portion of the oleic acid is separated; the solid residue is then to be purified by recrystallization from alcohol three or four times. Its formula is $HC_{18}H_{35}O_2$. When recrystallized from ether, until the fusing point becomes constant at 159°, and slowly cooled, the acid forms beautiful colorless, transparent, rhombic plates; these melt into a colorless oil, tasteless and without odor, and when quickly cooled the substance concretes in a white crystalline mass, which is insoluble in water, but readily forms with hot alcohol a solution having acid reaction. It is the material of the so-called stearine candles. Stearic acid exists in fats in combination with glycerine, forming stearine,

from which it is separated by saponification. (See GLYCERINE.) It combines with numerous bases, and forms with them both normal and acid salts, called stearates. Stearate of soda is the basis of ordinary hard soap; stearate of lead is a constituent of lead plaster.

**STEARNS,** a central co. of Minnesota, bounded E. by the Mississippi, and drained by Sauk river and lake; area, 1,379 sq. m.; pop. in 1870, 14,206. A portion of the county is prairie, but the W. part is hilly. There are numerous lakes and streams. It is traversed by the St. Paul and Pacific railroad. The chief productions in 1870 were 305,114 bushels of wheat, 78,627 of Indian corn, 447,193 of oats, 23,856 of barley, 120,865 of potatoes, 28,939 tons of hay, 17,701 lbs. of wool, and 323,085 of butter. There were 2,313 horses, 4,399 milch cows, 8,571 other cattle, 6,174 sheep, and 6,237 swine; 9 manufactories of carriages and wagons, 1 of agricultural implements, 4 of furniture, 7 breweries, 6 flour mills, and 5 saw mills. Capital, St. Cloud.

**STEATITE.** See TALC.

**STEDMAN, Edmund Clarence,** an American poet, born in Hartford, Conn., Oct. 8, 1833. He entered Yale college in 1849, was suspended in 1852, and did not return; but in 1871 the trustees restored him to his class and gave him the degree of A. M. After editing the "Norwich Tribune" and the "Winsted Herald," he settled in New York in 1855, and in 1859 became a writer for the "Tribune." In 1861–'2 he served as an army correspondent for the "World," and in 1863 he was private secretary to Attorney General Bates at Washington. In 1864 he became a stock broker in New York. He has published "Poems, Lyric and Idyllic" (1860); "Alice of Monmouth, an Idyl of the Great War, and other Poems" (1864); "The Blameless Prince, and other Poems" (1869); "Complete Poems" (1873); and "Victorian Poets," a volume of critical studies (1875).

**STEEL,** a malleable compound of iron and carbon, which may be hardened and tempered. Considerable confusion in the use of the word has arisen in late years, owing to the introduction of improved metallurgical processes, whereby wrought or malleable iron may be melted and cast into ingots. These ingots, having the appearance of ordinary cast steel and some of its properties, have likewise received the name of steel, although they lack the capacity of hardening which hitherto was regarded as the essential characteristic of steel. Pure or wrought iron possesses a high degree of malleability and ductility, is difficultly fusible, may be welded at high temperature, but below fusion, and is soft enough when cold to be readily wrought with tools. By the gradual addition of carbon to iron we notice an increase in fusibility, hardness, and resiliency, while malleability and ductility decrease. The smallest proportion of carbon which will distinctly produce these effects is about 0·25 per cent., and the largest amount of carbon which can exist in iron without destroying its malleability is about 2 per cent. Within these limits the compounds of iron and carbon possess the property of becoming soft when heated to redness and slowly cooled, and of becoming hard again when heated and quickly cooled. These processes of hardening and annealing may be repeated indefinitely, or until the carbon is burned out by the successive heatings. Iron with more carbon than 2 per cent. (say 2 to 5) is known as cast iron. It is more fusible than steel, but is not at all malleable, and while it may be hardened by sudden cooling, it is brittle and does not possess the resiliency or "spring" of steel. Soft or wrought iron has been until within the last 20 years worked by rolling or hammering when in a plastic condition at a red or white heat, owing to the impracticability of fusing pure iron. Steel was worked in the same manner as wrought iron until Huntsman succeeded in melting it in crucibles during the latter half of the last century, since when cast steel has replaced welded steel for most purposes, on account of its greater homogeneity, since all welded products consist of layers or fibres of metal separated by cinder, which, though it may be largely extruded by rolling or hammering, yet is always present to a sufficient extent to prevent the absolute contact of all the particles of metal. Since the idea of perfect homogeneity combined with malleability has so long been associated with our notions of steel, it was natural that when malleable iron, or iron low in carbon, was melted and cast in moulds, it should receive the name of steel without regard to the amount of carbon or the capacity for hardening. It is thus that the products of the Bessemer converter and the Siemens furnace have all been classed as steel, although the content of carbon may vary from 1·50 to 0·10 per cent.; and owing to the very large production of metal by these processes, far exceeding in amount ordinary cast steel, this classification has become well established in iron metallurgy. The uncertainty and confusion that has arisen from classing together products of widely different physical and chemical properties, has led to an active discussion of the definition and classification of steel. The classification of Greiner of Seraing is as follows:

| AMOUNT OF CARBON PER CENT. | Series of irons (welded). | Series of steels (melted). |
|---|---|---|
| 0 to 0·15 | Ordinary iron. | Extra soft steel. |
| 0·15 to 0·45 | Granular iron. | Soft steel. |
| 0·45 to 0·55 | Steely iron or puddled steel. | Semi-soft steel. |
| 0·55 to 1·50 | Cemented iron or steel. | Hard steel. |

While the simplicity and convenience of this classification from a manufacturing point of view must be admitted, its adoption is opposed by Gruner and others on the ground that it takes no account of the capacity for hardening.

—Among the elements other than carbon met with in steel are phosphorus, silicon, sulphur, and oxygen among the non-metals, and manganese, copper, tungsten, titanium, and chromium among the metals. Some of these are invariably present in the materials used for steel making, and are usually regarded as impurities in the steel, while others are added to produce certain specific effects. The modifications of the properties of steel by the above named elements have been already treated partially under IRON. Steel is more susceptible to the action of impurities than is wrought iron. This is especially true with regard to phosphorus and silicon, and is readily accounted for by the similarity of action of these substances with carbon. Recent experiments have shown that an amount of phosphorus which would be highly detrimental to steel containing say 0·50 per cent. of carbon, may be present with safety when the carbon is as low as 0·10 or 0·20 per cent., or in other words when the steel passes into soft iron. The effect of this formerly much dreaded enemy of iron and steel has been so thoroughly studied that "phosphorus steels," so called, are manufactured and sold. Phosphorus makes iron hard, brittle, and cold-short (see IRON), and this is also true in a modified degree of carbon and silicon; hence, when two or all three are present together in iron, the effect is cumulative. The contradictory statements as to the maximum percentage of phosphorus that Bessemer metal will bear find here their explanation. It was formerly said that Bessemer steel with more than 0·05 per cent. of phosphorus was unfit for rails, but later experience has shown that if the amount of carbon does not exceed 0·15 per cent., phosphorus to the extent of 0·35 per cent. may exist without seriously impairing the strength and ductility of the metal. This fact, recently brought into prominence by the manufacture in France of phosphorus steel on a large scale, was recognized in this country as early as 1870. Samples of boiler plate and tough steel made at Trenton, N. J., by the Martin process, showed on analysis the following composition:

| ELEMENTS. | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| Carbon | 0·160 | 0·120 | 0·120 | 0·125 | 0·120 |
| Sulphur | 0·003 | 0·008 | 0·007 | .... | ..... |
| Phosphorus | 0·530 | 0·113 | 0·275 | 0·314 | 0·272 |
| Manganese | 0·144 | 0·580 | 0·072 | .... | ..... |
| Silicon | 0·174 | 0·015 | 0·025 | .... | 0.052 |

While it appears from the above that phosphorus may in a measure replace carbon in steel, the effect of these two substances is not identical, and the limit of rigidity is much sooner reached with the former than with the latter. The use of phosphorus steel is solely a question of economic advantage, since its manufacture permits the use of impure and consequently cheaper materials; but as far as is at present known, the compounds of iron and phosphorus possess no properties that give them a superiority over the carbon compounds for industrial applications. The effect of silicon on steel appears to be similar to that of carbon, as the general analogy of the two elements would suggest; but to produce a given degree of hardness, the amount of silicon necessary is very much greater than that of carbon—the reverse of the case with phosphorus. The most contradictory statements exist regarding the effect of silicon on steel. The best established data are summarized by Turner as follows: A small amount of silicon is not necessarily injurious to steel, and may be an advantage in those varieties which are to be used without hardening, and where there is no special demand for tenacity and strength. On the other hand, where steel must be hardened for use, as for tools, silicon can only be injurious, and that in proportion to the quantity present. This is one reason why Bessemer steel cannot generally be used for purposes requiring a fine, hard steel; for it is usually made from highly silicious pig iron. But some of the Swedish Bessemer steel, made from pure manganiferous pig iron low in silicon, approximates in quality to ordinary cast steel. A puddled steel made with the addition of a highly silicious iron ore has been brought into prominence under the name of "silicon steel;" but there is no evidence that it derives any of its properties from silicon, or indeed that there is any more silicon in it than in ordinary puddled steel. The effect of sulphur on steel is entirely different from that of the elements already mentioned. It makes it "red-short," that is, brittle when hot; but unlike phosphorus, it does not sensibly affect its malleability when cold. The largest amount of sulphur that steel will bear without serious impairment of its malleability is said to be about 0·10 per cent. Oxygen produces the same effect on homogeneous iron as sulphur, as might be inferred from the close chemical relations of the two elements. It can never exist in the harder steels prepared by fusion, for it would then combine with the carbon; but it is frequently met with in the Bessemer low steels and iron, and makes them red-short. Red-shortness, formerly ascribed exclusively to sulphur, has been found in very many instances to be due to oxygen. Considerable importance has been attached to the presence of nitrogen in steel, and Frémy considers it an essential ingredient. Numerous analyses do not support this view, and it is probable that its presence in steel is entirely accidental and due to the property which many metals possess of absorbing or occluding gases. —The compounds of iron with the metals, or the true alloys of iron, have not been as closely studied as its compounds with the non-metals, and but little can be said with precision of the physical characters of these alloys as such, or as modified by the presence of the non-metallic elements. The properties of iron are not as radically modified by the addition of small quantities of metals as is the case with the

non-metals. Manganese is closely allied to iron in its chemical properties; and it plays a very important part, and one in many cases not well understood, in the preparation of steel. Ores containing considerable manganese are often known as steel ores. The beneficial effect of the addition of this metal or its compounds in the manufacture of crucible steel was discovered by Heath in England (patented in 1839), but the nature of its action is still somewhat obscure. Recent experiments by Caron show that sulphur is at least in part removed by manganese, and it is also probable that the presence of this metal in the steel prevents the injurious action of sulphur, although as a rule manganese added as oxide in the crucible does not enter into the composition of the steel. The part that it plays in the Bessemer and Martin processes is well understood, viz.: it removes the oxygen that the molten metal has absorbed, and thus corrects red-shortness, and it is probable that its favorable effect may be in many other instances referred to this action. The affinity of manganese for oxygen is much greater than that of iron, and therefore the reduction of metallic manganese from its oxide is accomplished with more difficulty; consequently a manganese cinder, unlike an iron cinder, protects the carbon of steel from oxidation. Further, when manganese is present in molten metal, the oxidation of the iron is prevented until all or nearly all the manganese is oxidized. Below a certain amount, say 1 per cent., manganese has been shown, contrary to former opinions, to exert no disturbing effect on the properties of steel. Greiner says that manganese possesses the property of rendering steel very malleable and weldable, and that hard steels containing sulphur, phosphorus, and carbon (as high as 1·50 per cent.) can be forged with ease if they contain sufficient manganese. Nearly all observers agree that it is a corrective of red-shortness. Manganese steel, so called, was for some time made in Leoben, Austria, but its manufacture was abandoned, owing to the uncertainty of the product. The combinations of steel with chromium, tungsten, and titanium have attracted much interest from the fact that they appear to have peculiar and valuable properties. They are often represented to be steels in which the metals named replace carbon. This view is inadmissible from a chemical standpoint, and it is probable that these compounds are carbon steels modified in their properties by the presence of other metals. An analysis of Mushet's "special" steel, generally supposed to be made from titaniferous ores, showed the presence of tungsten and no titanium, viz.: tungsten, 7·98 per cent.; carbon, 1·40; silicon, 0·24. This compound is excessively hard under ordinary conditions; on sudden cooling it breaks, and it can only be worked at a very low red heat. Tungsten has also been added in the Bessemer converter, and the resulting steel, containing as high as 0·558 per cent. of tungsten, was found to combine a high degree of toughness and capacity for hardening. Tungsten likewise increases the power of steel to retain magnetism. Titanium seems to produce effects similar to those of tungsten. Chromium also appears to confer valuable properties on steel, somewhat resembling those produced by tungsten. The "chrome steel" manufactured in Brooklyn, N. Y., combines in a high degree tenacity and ductility, and is capable of bearing a high heat for rolling, hammering, and welding. It is highly carburized, one sample giving 0·98 per cent. of carbon, and another 1·23. The amount of chromium found in one analysis was 1·66, and in another it did not exist in appreciable quantity. Determinations of the tensile strength of this steel by Kirkaldy of London, on bars 5 in. in length, varied from 115,780 lbs. to 167,320 lbs. per square inch, with an elongation in the first instance of 11·6 per cent., and in the second of 7 per cent. Determinations made at the West Point foundery ranged from 173,770 lbs. to 198,910 lbs. per square inch. When hardened at a very low heat, it acquires great hardness; a high heat renders it brittle, as might be expected from its large percentage of carbon. Copper is sometimes an accidental ingredient in steel. It seems to make it red-short, and its presence even in small amount is believed to be highly deleterious. Faraday and Stoddart have experimented on alloys of steel with the noble metals. They found the compound of steel with a small amount of silver to have valuable properties, but its expense would be a barrier to its introduction. Many analyses of fine steel have shown the presence of aluminum; and it is not improbable that this metal exerts a favorable action on steel, but the subject has not been investigated.—Classification and Manufacture of Steels. For the purposes of description of steels and the processes of their manufacture, a classification based on the mode of production may be found convenient. When iron ore is used, the process is one of deoxidation and subsequent carburization; with pig iron it is one of decarburization; and with wrought iron it is one of carburization. The following outline of processes is arranged on this plan:

1. Steel from the ore direct, by reduction and carburization. Ore steel, direct steel. Example, bloomary steel.
2. From pig iron by decarburization.
   - *a.* By solid oxidizing agents, as iron ore, saltpetre, &c., without fusion. Examples, puddled steel, Heaton steel.
   - *b.* By solid oxidizing agents with fusion. Example, Uchatius steel.
   - *c.* By the oxidizing agency of air, with fusion. Example, Bessemer steel.
   - *d.* By oxidizing and reducing gases. Example, the Bérard process.
3. From wrought iron by carburization.
   - *a.* By fusion with pig iron. Example. Martin steel.
   - *b.* By fusion with coal or carbonaceous substances. Example, Indian steel or wootz.
   - *c.* By heating in charcoal without fusion. Example, cement steel.
   - *d.* By heating in carburetted hydrogen, without fusion. Example, Mackintosh or Baron steel.

The distinction between crude and fine steel is not now so sharply defined as formerly, but in

general the term fine steel is reserved for those products made by fusion of the purest materials in a crucible, and particularly for the cast steel made by fusion of cement steel. Shear steel, produced by welding and rolling cement steel, may also be classed here. In many instances two or more reactions or processes for steel making are combined, but in following the above classification the principal feature only of the process is considered.—1. *Steel direct from the Ore.* The process for obtaining wrought or soft iron direct from the ore (see BLOOMARY, and IRON) affords, with some slight modifications of charging and manipulation, a product containing sufficient carbon to entitle it to rank among the steels; but the steel thus produced is always low in carbon, and may be classed with puddled steel. In the Catalan or bloomary forge the circumstances favoring the production of a steely product are: a slow process, that the reduced iron may have time to absorb carbon; the protection as far as possible of the mass of plastic metal from the direct action of the blast and from the action of rich iron cinder; and also the use of manganiferous ores, since the oxide of manganese, as already explained, does not oxidize carbon readily. The character of the steel produced by the bloomary depends on the nature of the ores and the skill of the workmen. The impurities of the ores are more completely eliminated in the direct processes than in the blast furnace process, a gain obtained at the expense of a considerable loss of iron. Titaniferous ores can be successfully worked in the bloomary, and are said to give a superior steel. The product of the bloomary generally lacks uniformity, a defect which can be remedied by repeated heatings and hammering. The bloomary process is rarely used now for the direct production of steel, but the iron made by this process is, on account of its purity, advantageously employed for conversion into steel by the cementation process.—2. *Steel from Pig Iron.* 2*a. Puddled Steel.* The process of puddling for steel does not differ essentially from that for iron. (See IRON MANUFACTURE.) The operation is stopped before complete decarburization, or when the desired hardness is attained. The conditions favoring the production of steel in the puddling furnace are as follows: 1. Pure pig iron is necessary, since the refining is not carried as far as with wrought iron, and also because a less basic cinder is employed. 2. The pig iron should be highly carburized, that it may not come to nature too quickly. 3. It should not contain too little silicon, or the cinder will be too basic or "rich." 4. The presence of manganese is favorable, as it produces a fluid and non-oxidizing cinder. 5. The cinder should be "poor" or highly silicious, since rich cinder decarburizes the metal. 6. The process should go on slowly, that it may be the more under control. 7. During the balling the temperature must be reduced as much as possible, and a smoky flame produced, to prevent oxidation. The nature of puddled steel has already been considered in the foregoing. It possesses a degree of hardness proportional to the amount of carbon (which rarely exceeds 0·5 per cent.), and a fibrous or welded structure. It has been largely used for the heads of rails, being much more readily welded to iron than ordinary cast steel. Puddled steel made from pure pig irons is also much used for melting in crucibles for the production of fine cast steel. Saltpetre (potassium nitrate) has been used for the conversion of pig iron into wrought iron and steel. Its action is both oxidizing and purifying, the former through the large amount of oxygen of the salt which is readily given off, and the latter through the strong base, potassa, which combines with the silicic and phosphoric acids produced. The apparatus devised by Heaton for the reaction between molten cast iron and saltpetre, for the conversion of poor pig iron into good steel, has been abandoned on account of the expense and uncertainty of the process. 2*b. Uchatius Steel.* Steel produced by the reaction of pig iron and iron ore may be obtained in the molten condition, if the temperature of production is high enough. This is effected either in a crucible or in a Siemens regenerative furnace. Uchatius steel, named from its inventor, is made by fusing a mixture of granulated pig iron, iron ore, and oxide of manganese in crucibles. Its manufacture is now confined to Sweden (though originally introduced in Austria), where the pure irons and ores are admirably adapted to the process. At the Siemens works in Landore, Wales, the manufacture in the open hearth is regularly carried on by mixture of pig iron and iron ore. The process differs from that of Uchatiüs in that the ore is added in successive portions, and that to the decarburized metal spiegeleisen is added, as is usual in the open-hearth processes. Scrap iron is also sometimes added, but its use is not essential to the process. The charge consists of 5 to 6 tons of Bessemer pig iron and 30 cwt. of pure ore. The product is used principally for rails, and averages 0·40 per cent of carbon. 2*c. Bessemer Steel.* The Bessemer or pneumatic process consists in the removal of the carbon, silicon, &c., from pig iron by means of a blast of air forced through the molten metal. The reactions involved are in many respects the same as those in the puddling process; that is to say, the silicon is first oxidized, and the silica thus formed combines with the oxides of iron and manganese (if present) to form a cinder, and the carbon is subsequently oxidized to carbonic oxide. Owing, however, to the rapidity of the process and the large amount of pig iron employed, the heat developed in the oxidation of the silicon, carbon, &c., is sufficient to retain the resulting steel or iron in a fluid condition, so that it can be cast directly into moulds. The history of this remarkable

process is briefly as follows: On Oct. 17, 1855, Henry Bessemer patented a process of blowing air or steam through molten pig iron in crucibles, until the metal was decarburized to any desired extent. At this time he recognized the fact that while steam cooled the metal, air increased the heat from red to white. A patent in December of the same year specified a circular or elliptical vessel provided with a refractory lining and hung on trunnions, which could be filled and emptied by means of a lipped opening. In this patent the essential features of the process were fully developed. A patent of Feb. 12, 1856, indicated that the heat developed in the process was sufficient without the additional use of fuel, and that, according to the duration of the blowing, steel or soft iron might be produced. In July, 1856, Bessemer read a paper before the British association at Cheltenham on the "Manufacture of Iron and Steel without Fuel," which created an intense interest. But the subsequent trials did not yield uniformly satisfactory results, and except by the inventor the process was practically abandoned. Patient and careful experiments showed that not all pig irons were adapted to the process; that sulphur and phosphorus were not eliminated, and consequently pig irons containing a notable proportion of these substances could not be used. Again, the interruption of the process at the precise point of decarburization desired was found to be impracticable, owing to lack of trustworthy indications. Further, it was found that the process was not adapted to making the finer and harder steels, but had its chief application in the production of low steels or soft iron. The absorption of oxygen, and the consequent red-shortness of the metal when the pig iron was blown to nearly complete decarburization, was overcome by the addition of spiegeleisen, a white pig iron containing from 7 to 12 per cent. of manganese. This was a suggestion of Robert Mushet, and to it the practical success of the Bessemer process is largely due. After conquering all the obstacles to success, Bessemer did not find a ready acceptance of his process owing to the distrust caused by his previous failures. He therefore started in 1859 a small establishment of his own in Sheffield for the regular manufacture of his steel. His commercial success soon led to the general adoption of his process throughout the civilized world, more particularly at first in Sweden, where the pure ores and fuels furnished a pig iron admirably adapted to the process. In 1867 there were in England 52 Bessemer converters, in Prussia 22, in France 12, in Austria 14, in Sweden 15, and in Belgium 2. In 1873 Germany alone had 70 converters, and the number had risen in England to 105. The production in England has increased from 6,000 tons in 1867 to 540,000 tons in 1874.—The Bessemer process consists, first, in melting the pig iron; second, transferring the molten metal to the converter, where it is subjected to the action of the blast of air; third, pouring the finished product into a ladle; and fourth, pouring from the ladle into the mould. The metal when solid, but while still hot, is taken from the moulds and worked by rolling or hammering into the desired form. Pig iron is in some cases used direct from the blast furnace, but remelting is generally found advantageous. The furnaces now used for this purpose are generally cupolas, which melt quicker and are more economical, although the direct contact of the iron with the fuel may cause a deterioration of the metal if the fuel is impure. The reverberatory furnace is not open to this objection, but the pig iron may here suffer a loss of silicon and manganese, owing to the oxidizing atmosphere. The molten metal is either run in troughs directly from the furnace to the converter, or is first run into ladles where it can be weighed, and thence carried to the converter. The latter is a pear-shaped vessel, sometimes called the retort or simply the vessel, consisting of an iron mantle lined with a refractory silicious material. It is usually made in two parts, upper and lower, for convenience of lining. The bottom, which contains the tuyeres, is made in a separate conical piece, and inserted from below. The size of the converter is usually calculated for a charge of five to six tons of pig iron. This amount of metal occupies but a small part of the vessel, as is indicated in the accompanying figures. The greatest external diameter is about 8 ft., with a total height of from 12 to 15 ft. The silicious material of the lining usually contains a little alumina. The so-called "ganister" used in England for this purpose is a ground sandstone found in the coal formation, containing 93 per cent. of silica, 4 per cent. of alumina, and 1 to 2 per cent. of oxide of iron. The lining is made by ramming the material in a moist condition around a form placed in the converter. It is usually about 12 in. thick. The greatest attention must be paid to the selection of the material for the

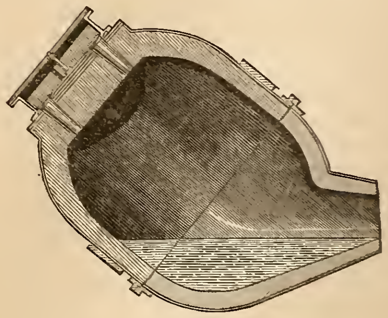


Fig. 1.

lining and to its thorough consolidation, for upon the lining the success of the process largely depends. The tuyeres, from 7 to 12

in number, are made of fine clay in the form of truncated cones, each perforated with 7 to 12 holes about three eighths of an inch in diameter. They are arranged on the bottom plate, and ganister or other material stamped around them; and the finished bottom, after drying, is inserted in the converter. The bottom lasts generally for 6 to 10 heats, while a carefully made lining may endure 1,000 or more heats. The converter is mounted on trunnions, one of which is hollow and conveys the blast to the tuyere box below the tuyeres, and to the other is attached the mechanism by which the converter is revolved. Figs. 1 and 2 give sectional views of the converter in two positions. Fig. 3 is a plan of the converter with the rotating machinery. The ladle into which the steel is poured from the converter is shown in figs. 4, 5, and 6. Fig. 4 is a vertical section of the ladle crane and elevation of the ladle. Fig. 5 shows the platform on which the ladle moves, and fig. 6 is a partial section through the ladle, showing the loam-coated rod which acts as a stopper in pouring. By this latter arrangement the fluid steel is discharged in a thick stream, and the cinder remains on top. The steel is usually cast in long ingots about 12 to 14 in. square at the base and tapering from 1 to $1\frac{1}{4}$ in., each ingot being rolled into two or three rail blooms. When the steel is intended for other purposes than rails, moulds of special forms are used. To obviate the occurrence of air bubbles in the steel, caused by the falling of the stream from the top to the bottom of the mould and spattering against the sides, bottom casting is employed; that is, pouring the steel down a central sprue and causing it to enter the bottom of several moulds at a time through fire-clay distributors. The blowing engine for supplying the blast is usually double, and should be able to deliver 8,000 to 11,000 cubic feet of air a minute at a pressure of 25 lbs. to the square inch. Probably no other invention of the magnitude

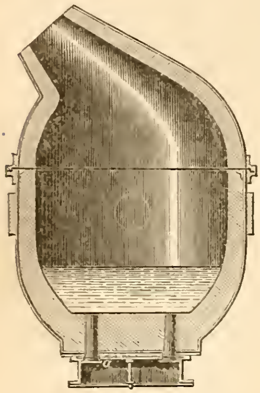


Fig. 2.

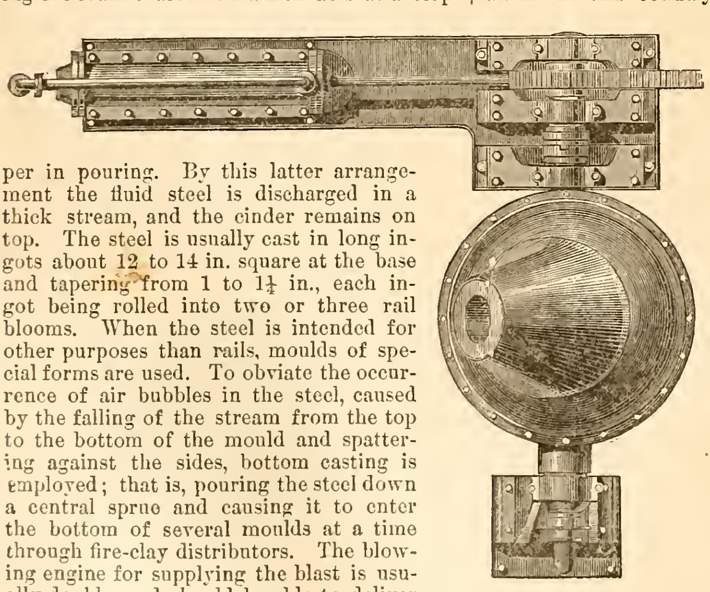


Fig. 3.

of the Bessemer process ever came from the hands of its inventor in as complete a form. But while the accumulated experience of 15 years has added nothing to the essential features of the apparatus and machinery, yet in the minor details of construction improvements have been made which have increased the capacity of the process four fold. The highest perfection of apparatus and working has been attained in the United States, where there are now (1876) ten works with two converters each, of five to six tons capacity. The improvements in American practice have been largely due to Mr. A. L. Holley, who has superintended the construction of most of the works in this country. In 1868 an output of 500 tons a month from two five-ton converters was barely reached. The production had gradually increased to 4,200 tons of ingots a month in the best works, in others to 3,800 tons, and in one instance to 5,000 tons. In the nominally five-ton vessels $5\frac{1}{2}$ to $5\frac{3}{4}$ tons are sometimes produced at a heat. The improvements which have rendered this large and regular production possible in this country, far exceeding that of European works, have been summed up by Mr. Holley as follows: 1, improved cupola furnaces and method of working; 2, the means used for quickly and soundly renewing the vessel bottoms, and the use of fire brick around the tuyeres;

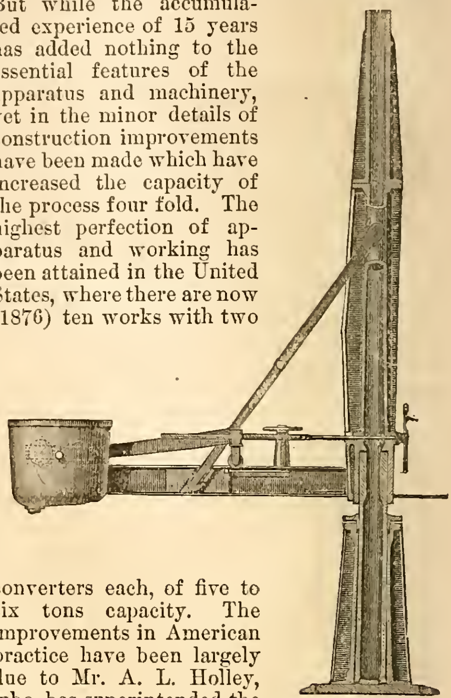


Fig. 4.

3, more roomy and convenient arrangement and distribution of the working parts and spaces; 4, filling the ingot moulds from the bottom by improved and convenient appara-

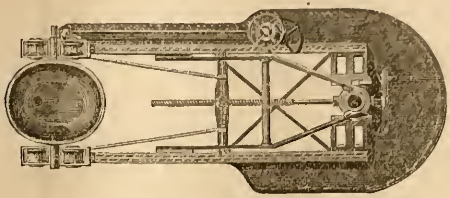


Fig. 5.

tus.—The converter, after being lined, is thoroughly dried and heated to redness, and pig iron is run into it while turned to the horizontal position. On tipping up the converter, it is necessary that the blast should be started before the metal reaches the tuyeres. This is effected automatically by a cam on one of the trunnions. When the converter has attained the upright position, the roar of the air rushing through the metal and escaping from the mouth is heard. In this stage a large part of the oxygen is absorbed by the silicon and manganese (or iron in the absence of manganese), and the flame is short and not highly luminous. The spectroscope shows at this time a continuous spectrum without lines. Soon the escaping flame increases in size and brilliancy, assuming an orange or yellow color with blue streaks and a white edge, intermingled with sparks of metal. The spectroscope now shows the sodium line, and generally those of potassium and lithium, accidental ingredients of the metal or lining. This constitutes the first period of the conversion, and is known as the slag or cinder-forming period. The action now becomes more violent, and the flame more intensely luminous, and large masses of iron or cinder are often ejected from the vessel, probably from the energetic action of the oxide of iron in the cinder on the carbon of the metal. The spectroscope now shows bands of dark lines in the green, which have been proved to be produced by manganese, though their appearance is dependent on the oxidation of the carbon. This violent stage of the process passes gradually into the third and more peaceful period, in which the flame increases in heat and brilliancy and assumes a purple or violet tint. At this high temperature the carbon appears to be directly oxidized by the blast. When the carbon is all removed the flame suddenly drops, which is the indication for tipping over the converter and stopping the blast. Coincident with the dropping of the flame is the disappearance of the dark bands from the spectrum. The length of the process up to this point may vary from 5 to 45 minutes, according to the heat of the metal, the amount of silicon and manganese, and the amount of pressure of blast. A "blow" usually lasts 15 to 20 minutes, of which the first or slag-forming period generally occupies one half. Pig irons with little silicon often pass directly into the second period. The metal in the converter after complete decarburization contains considerable oxide of iron in suspension or solution, and in that condition is worthless, since it breaks up under the hammer. There is added to it, therefore, metallic manganese, as before explained, which combines with the oxygen and passes into the cinder. Spiegeleisen is generally used for this purpose. At the end of the blow the converter is tipped over, and the spiegeleisen, previously melted, is run in. An energetic action at once manifests itself by the escape of abundant gas and flame. About 7 to 10 per cent. of the weight of the charge is used, according to the hardness of steel desired. Spiegeleisen contains about 4 to 5 per cent. of carbon, and the amount that can be used is therefore limited, for the carbon, taking but little part in the reaction, enters into combination with the metal. This has been an obstacle to the preparation of extra soft metal by the Bessemer process. Ferro-manganese, a combination of manganese and iron with a little carbon, containing 50 per cent. more or less of manganese, was early used with success in the process, but its manufacture was abandoned owing to its expense. It has recently been revived and its use resumed in the Bessemer, but more particularly in the Martin process, under analogous conditions, for the preparation of steel or homogeneous iron containing phosphorus. The employment of ferro-manganese is also becoming general for making soft iron of fine quality for construction of ships, bridges, &c. The addition of spiegeleisen or ferro-manganese is not universally practised. Where the pig iron contains considerable manganese, the process may be interrupted at the desired stage of decarburization, and even metal very low in carbon, which is not red-short from oxide of iron, may be successfully cast. This method is followed in Sweden and some parts of Germany. The loss of weight in the conversion of pig iron by the Bessemer process, including scrap, is from 10 to 15 per cent. The heat produced in the process, formerly supposed to be mainly caused by the oxidation of the carbon, is now known to be mainly due to the oxidation of silicon and manganese, and also of the iron. Silicious pig iron is therefore generally demanded for the process. From $1\frac{1}{2}$ to 2 per cent. of silicon is the amount generally desired, but pig irons with more and less are often used. The use of more silicious pigs is disadvantageous owing to a lengthening of the

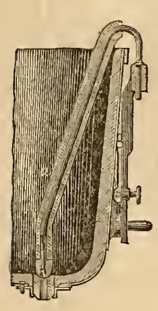


Fig. 6.

process, and also to the large amount of silicon remaining in the steel. When highly manganiferous pig is used, the silicon may sink below 1 per cent., and the resulting steel is of a much finer quality. Much of the Swedish Bessemer steel, celebrated for its purity and strength, is made from pig iron of this character.—The heavy ingots of Bessemer steel intended for rails are either hammered or rolled (bloomed), becoming thereby condensed and elongated, and then cut into lengths suitable for rolling into rails. Blooming is now generally conceded to make the best and most uniform product. The American blooming train consists of three rolls 30 in. in diameter and 5 ft. in length, which are adjustable in housings by means of steel screws. Ingots 12¼ in. square are reduced by four grooves and 17 passes to 6 or 7 in. square in four minutes. Special appliances for manipulating these heavy masses of metal by machinery are attached to the rolls and greatly facilitate the operation, which in some cases is nearly automatic. The rail trains are ordinarily three high rolls. (See Iron Manufacture.) A 21-inch train for rolling 7-inch ingots into rails in 13 passes is divided into three lengths. The product of a steel rail mill, working on 7-inch blooms, is about 1,000 tons of rails a week. The consolidation of steel usually accomplished by hammering or rolling may also be effected by the application of a heavy, steady pressure. This latter method is applicable not only to the forging of masses of steel, but also to the compression of the metal while in the molten state. Bessemer embodied this idea in one of his earlier patents. Originally practised in France, the compression of liquid steel has attained its greatest development in England, where Sir Joseph Whitworth has an extensive plant for this purpose, which includes four hydraulic presses capable of exerting a pressure of 2,000 to 8,000 tons. The pressure usually applied is six tons to the square inch, by which an ingot is reduced one eighth in length. To small castings a pressure of 20 tons to the square inch is sometimes applied. Mild steels treated by this process have shown a tensile strength of 40 tons to the square inch, with an elongation of 30 per cent. A tube of this compressed steel 26 in. long and 7·83 in. in diameter, with a bore of 2·56 in. (being that of a nine-pound field gun), sustained 48 explosions of 1½ lb. of powder with the bore closed by a screw plug, the only escape for the gases being through the touch hole, $\frac{1}{10}$ in. in diameter. The expansion of the bore increases at every explosion, but without rupture. Forging steel by means of hydraulic pressure was first introduced by Haswell in Vienna in 1861. Heavy ingots are forged by this method more effectually than by hammering, and smaller articles of irregular or intricate outline, up to 150 lbs. or more, may be directly formed by pressure of the white-hot metal into moulds. 2*d. The Bérard Process.* The conversion of pig iron into steel or soft iron by means of oxidizing and reducing gases, in this process, is carried out on the hearth of a reverberatory furnace heated by gas. The pig iron is decarburized by means of air in connection with hydro-carbon gases, which are expected to remove the sulphur and phosphorus. The resulting iron is recarburized by the reducing gases. This process has not yet proved a commercial success.—3. *Steel from Wrought Iron.* The above described processes under the second division of the classification, to which many others of minor importance might be added, all use pig iron as the principal material for the preparation of steel; and as it is a substance of complex and variable composition, the quality of the steel derived from it will depend on the composition of the pig iron used. In none of the processes using pig iron is there a complete elimination of all the substances associated with the iron; hence only the purer varieties can be used where a good product is desired. In the third division wrought iron is the principal material used, and as this may be made in a state of great purity even from moderately pure pig irons, the steel made from it is as a rule superior to that made from pig iron. Wrought iron when imperfectly worked contains considerable cinder, which holds the greater part of the phosphorus originally in the pig iron; and when steel is made from such wrought iron by fusion, the phosphorus enters the steel. 3*a. The Martin Process.* The principle of manufacturing steel by the reaction of wrought iron upon melted pig has long been known. Rinmann, Vanaccio, and even Agricola (about 1550) describe processes of this kind. Réaumur (1722), Chulut, and Clouet (1778) published experiments in which steel was produced by the simultaneous fusion of cast and wrought iron, or of cast iron and iron oxide. But these experiments, and many others of subsequent date, were successful only so far as the manufacture in crucibles was concerned. It was only in closed vessels, heated from without, that the necessary high temperature, combined with exclusion of air, could be maintained. Vitreous fluxes were early used, to protect the surface of the molten metals; and the idea of employing a reverberatory furnace is found in the work of Hassenfratz (1812). Several English and French patents of the early part of this century show that metallurgists were actively engaged with this problem. The most important historically, though at the time without commercial results, was that of Heath (1845), which indicated the fusion of material in a hearth, the maintenance of an extremely high temperature, and the employment of gaseous fuel. In a former patent (1839) Heath had claimed the addition of carburet of manganese. The oxides of manganese had been previously used in metallurgy; but the introduction of metallic manganese, alloyed with carbon, was an important novelty, which prefaced the employment by Mushet, Bessemer,

and Martin of the "triple compound" of iron, carbon, and manganese (spiegeleisen). The chief difficulty with all these attempts to manufacture steel by fusion in the reverberatory was the lack of efficient and economical means for the maintenance of the intense temperature required. This was supplied by the important invention of Siemens, the regenerative gas furnace (see FURNACE), in which the use of gas as fuel was perfectly realized. The effect of this invention was great and immediate in every branch of metallurgy involving very high temperatures, and nowhere more signal than in the remelting and subsequently in the direct manufacture of steel by fusion. Sudre, Alexandre, Attwood, and Brigues, Rambourg and co. (the last at Montluçon, under the advice of C. W. Siemens himself) attempted with the aid of the new system of heating to fuse cast iron with wrought iron or oxides of iron for the production of steel, and procured patents on the strength of their experiments. But the first practical success was that of Pierre and Émile Martin, whose method is set forth in their patents of 1865 and 1867. These metallurgists, after a series of experiments extending over many years, arrived at a combination of features, most of them separately known before, but constituting as a whole a new process, by which they were enabled to manufacture open-hearth steel of all grades, from the homogeneous metal approaching wrought iron to the hardest varieties, on a commercial scale and with profit. Naturally their claims as inventors, among so many eager competitors, were for a time contested; but the report in their favor of MM. Jordan and Burat, made in November, 1874, after an investigation extending over many months, for the tribunal of the Seine, will probably be accepted as conclusive. The Martin process is now widely employed in England, on the continent of Europe, and in the United States, and constitutes the only rival of the Bessemer method for the production of cheap steel. It consists essentially in the decarburization of cast iron by fusion with wrought iron, iron sponge, steel scrap, or iron oxide, in the hearth of a reverberatory furnace, heated with gas, the flame of which assists the reaction, and the subsequent recarburization or deoxidation of the bath by the addition at the close of the process of white iron, spiegeleisen, or ferromanganese. The period of fusion and decarburization lasts from four to eight hours; the amount of spiegeleisen or ferro-manganese added depends upon the condition of the bath, the grade of steel desired, and the percentage of manganese in the alloy used. The first of these elements is determined by samples taken from time to time during the process and tested. The advantages claimed for the Martin as compared with the Bessemer process are: its less expensive plant; the greater duration of the operation permitting by means of sampling more complete control of the quality of the product, and also conducing to greater uniformity of result; and, as a consequence of the foregoing, the practicability of employing materials which have not hitherto been considered suitable for the Bessemer converter. The greater variety of materials available for the Martin process also renders the direct conveyance of the molten pig from the blast furnace to the steel furnace an easier matter in this process than in the other, since the initial quality of the pig is of less importance. Yet this direct conveyance of the cast iron has thus far been practised in certain Bessemer works alone. The Martin process has been employed at Terre Noire in France, and by Mr. Slade at Trenton, N. J., for the production of phosphoric steel mentioned above. The production of Martin steel in this country has risen from 3,000 net tons in 1872 to 7,000 tons in 1874. The number of establishments using the process in 1874 was 13, and its introduction was in progress in other works. 3*b*. *Indian Steel, or Wootz.* This is produced by fusion of wrought iron with coal or carbonaceous substances in crucibles. Small pieces of iron made in the small native furnaces are put into a clay crucible with some dried wood and leaves, and covered securely with tempered clay. The crucibles are then heated until fusion is complete, when they are broken open, and a conical mass of steel weighing 2 or 2½ lbs. is obtained. This steel is generally very highly carburized, and requires to be worked at a low heat. It is much esteemed for its purity, but the production is small in amount. About the beginning of this century David Mushet carried out an extensive series of experiments on the fusion of wrought iron and charcoal in crucibles, and determined the amount of charcoal necessary for the production of steel of different degrees of hardness. Since then numberless patents have been secured for mixtures for fusing in crucibles, comprising mainly the different varieties of pig iron, wrought iron, carbon, and oxide or other compound of manganese. The crucible steel of the present day is largely made from such mixtures, the quality of the product depending on the materials used. 3*c*. *Cement Steel.* The production of steel by heating wrought iron in charcoal without fusion (cementation) is a very old process, but its origin is unknown. It was described by Réaumur in 1722, and has not been materially changed since. Notwithstanding the introduction of modern processes, this method is still employed for the manufacture of the higher grades of steel for tools and other fine purposes. The iron is in the form of flat bars about ¾ in. thick. These are arranged in layers in long boxes or chests of fire brick, each layer being covered with charcoal about ½ in. thick. When the box is full, it is covered with clay or other impervious material, and heated to bright redness for seven to ten days, according to the degree of carburization re-

quired. Trial bars are inserted with their ends protruding, which may be withdrawn from time to time and the progress of the conversion judged from the appearance of the fracture. When the desired end has been attained, the fires are withdrawn and the boxes allowed to cool slowly for several days. The bars after conversion generally have blisters on the surface, apparently formed by the pressure of some gas from within the bar; hence the name "blister steel." The bars, originally soft and tough, are found after conversion to be hard and brittle, and the freshly fractured surface shows a steely appearance. Analyses of successive layers of the bar after conversion show that the carburization proceeds gradually from the surface to the interior, the iron near the surface being much more highly carburized than that at the centre. In order to obtain uniformity in cement steel, it is therefore necessary either to weld several bars together by repeated rolling or hammering, or by melting the bars in crucibles. The former process is adopted only for the softer cement steels, and furnishes shear steel. The use of this welded steel has been generally superseded by cast steel, but it is still employed for many purposes, particularly for welding to iron. The melting of steel is usually effected in covered crucibles capable of holding 40 to 80 lbs. of metal. They are made of refractory clay or of graphite with sufficient clay to give it coherence. These crucibles are placed in furnaces arranged in a straight line, with their tops or openings on a level with the working floor of the casting house. Each furnace is a rectangular chamber of fire brick, capable of holding two crucibles, and has a separate flue. Siemens's regenerative furnace is also largely used for heating crucibles for steel melting. When the steel is thoroughly melted the crucible is drawn out of the furnace, and the molten metal cast in the form of rectangular ingots or into special moulds. Where large castings are to be made of crucible steel, the metal from several crucibles is first poured into a common receptacle, and thence into the moulds. Case-hardening of wrought iron consists in a superficial conversion of the iron into steel by heating it with animal charcoal or organic matters in the same manner as that employed for cement steel, but for a shorter time. Or the iron to be hardened may be simply heated to redness and covered with a carbonaceous substance like prussiate of potash or cyanide of potassium, which will cause a superficial carburization. Case-hardening is employed for objects which should have a hard and steely surface combined with the toughness of wrought iron. 3*d*. *Mackintosh or Baron Steel*. The carburization of wrought iron by means of gaseous hydrocarbons without fusion was proposed in 1824, and was patented in England in 1825 by Charles Mackintosh. It has recently been revived under the name of the Baron process, but has not been made practically successful. The conversion is effected at a white heat, and is said to be complete in a few hours.—The limits of this article would not admit of even the enumeration of all the steel-making processes which modern inventors have suggested or endeavored to carry out. A large number of these inventions deal with the direct production of steel from the ore by processes similar to those described under IRON MANUFACTURE, and a still larger number with the direct conversion of pig iron into steel.—PROPERTIES AND TREATMENT OF STEEL. The physical properties of steel vary according to its composition, structure, and treatment. Thus the specific gravity of blister steel was found by Kirkaldy to vary from 7·7080 to 7·7327; of puddled steel, from 7·6237 to 7·7345; and of cast steel, from 7·8110 to 7·8303. The effect of the amount of carbon, and also of hardening, on the specific gravity, is shown in the following series of Swedish Bessemer steels:

| PER CENT. OF CARBON. | Sp. gr., soft. | Sp. gr., hardened. |
|---|---|---|
| 1·5 | 7·785 | 7·736 |
| 1·2 | 7·832 | 7·771 |
| 0·9 | 7·874 | 7·803 |
| 0·6 | 7·879 | 7·807 |
| 0·4 | 7·893 | 7·839 |

The appearance of the freshly fractured surface of cast steel depends likewise on the amount of carbon and on the degree of hardening. The more carbon present, the closer and more highly crystalline is the grain of the steel, and the lighter the color; effects which are all enhanced by hardening. Steel, unlike soft iron, has the property of retaining magnetism, its capacity in this regard increasing with the amount of carbon.—*Hardening, Tempering, and Annealing*. Steel is hardened by suddenly cooling it from a red heat through immersion in water, oil, or other liquid. The degree of hardness thus produced is proportional to the amount of carbon in the steel and the rapidity of its cooling. Hardened steel heated to redness and allowed to cool slowly recovers its original softness and malleability (annealing); but when hardened steel is heated to a temperature considerably below redness, and cooled, it is only softened to a degree inversely proportional, generally, to the temperature of the previous heating. This process is called tempering. For temperatures considerably below red heat, it is practically indifferent whether the cooling be slow or rapid. The operations of hardening and tempering are dependent on many conditions, such as the composition of the steel, the temperature to which it is heated, the temperature, specific heat, boiling point, mobility of particles, and heat-conducting power of the liquid in which it is cooled, &c. The following table shows the temperatures employed in tempering for different purposes, and the color indicative of each temperature, which appears on the surface of polished steel as it reaches the given degree. From these

colors, probably due to superficial oxidation, the experienced workman judges of the temper which the steel will assume:

| TEMPERATURE. | | Color. | Corresponding temper, suitable for |
|---|---|---|---|
| Fahr. | Centigrade. | | |
| 430° | 221° | Very pale yellow. | Lancets. |
| 450 | 232 | Pale straw. | Razors and surgical instruments. |
| 470 | 243 | Full yellow. | Penknives. |
| 490 | 254 | Brown. | Scissors, cold chisels. |
| 510 | 265 | Brown with purple spots. | Axes, plane irons. |
| 530 | 277 | Purple. | Table knives. |
| 550 | 288 | Bright blue. | Sw'ds, watch springs. |
| 560 | 293 | Full blue. | Fine saws, augers. |
| 600 | 316 | Dark blue. | Hand and pit saws. |

Polished articles may be heated for tempering over or between iron plates, in a gas flame, in molten lead, or in various other ways, until the proper color appears. For articles not polished, the temperature must be otherwise determined, as by heating in oil or tallow or in alloys of known fusibility. When oil or melted tallow begins to smoke, its temperature corresponds with that indicated by straw color on the polished steel; darker and more abundant smoke corresponds with brown; black and still more abundant smoke rises at 530°, the temperature of purple; when the vapor takes fire from a lighted taper, without continuing to burn, the temperature is about 580°; and finally, when the oil burns and rises in the vessel, the point of dark blue has been reached. The following table shows the fusing point of several alloys of tin and lead:

| Lead, parts. | Tin, parts. | Fusing point, deg. F. | Lead, parts. | Tin, parts. | Fusing point, deg. F. |
|---|---|---|---|---|---|
| 7 | 4 | 420 | 19 | 4 | 509 |
| 7½ | 4 | 430 | 30 | 4 | 530 |
| 8 | 4 | 442 | 48 | 4 | 550 |
| 8½ | 4 | 450 | 50 | 2 | 558 |
| 10 | 4 | 470 | Boil'g linseed oil | | 600 |
| 14 | 4 | 490 | Melting lead.... | | 612 |

Steels containing other substances besides carbon appear to require different treatment from pure carbon steels. Thus tungsten and titanium steels, so called, if heated bright red and suddenly cooled, are said to become excessively brittle; they must therefore be manipulated at low temperature. Too little is known of these compound steels to permit inferences as to their physical behavior. The hardening of large or irregular masses of steel requires great care. Unequal cooling causes fracture. Generally the more massive portions are first dipped in the liquid, and the thinner portions last; or, in case of any great disparity, special means are adopted to retard the cooling of the smaller parts. The causes of the phenomena attendant upon hardening and tempering steel were long involved in mystery, and are not yet all known with certainty. What is clearly known on the subject may be briefly stated. The degree of hardness assumed on cooling by a given steel is dependent on the rate of cooling. Caron says the degree of hardening is inversely proportional to the square of the time. The liquids which favor rapid cooling are those having a high specific heat and a low boiling point. Water fulfils these conditions in an eminent degree, while oil has a much lower specific heat and a much higher boiling point; consequently cooling in oil is a more gradual process than in an equal volume of water. Increasing the volume of the liquid and maintaining agitation, so as to diffuse rapidly the heat received from the steel, of course hastens cooling. The most rapid cooling is produced by mercury, by reason of its high conducting power. It is sometimes used to produce extreme hardness. But obviously the initial temperature of the cooling liquid is an essential point; so that heated mercury or fusible alloys could be used to effect slow cooling. Ordinary tempering is a partial annealing; that is, excessive hardness having been imparted to the steel, the excess is removed to the degree desired. It has been found in most cases practically easier to attain an accurate result in this way than by a single process of hardening, arrested at the desired point. But recent experiments by Caron have shown that it is possible, in some cases at least, to effect the hardening in one operation by carefully adjusting the amount and temperature of the water. Water at 131° F. was found to give results with some objects equal to those produced by the most careful hardening and tempering. Caron has further found that hardening of steel with 0·2 to 0·4 per cent. of carbon in warm, or still better in boiling water, was accompanied by an increase of its tenacity and elasticity without a material impairment of its hardness.—The toughening of large steel objects, such as cannon, is effected by heating them to redness and immersing in oil, where they gradually cool. This process has been recommended for steel rails. The hardening of steel is probably due both to a chemical combination of the carbon (present partly as graphite in soft steel) with the iron, and to a state of tension among the particles, conditions which are both removed by annealing. The tension in a bar of hardened steel is shown by cutting it in two lengthwise, when each piece assumes a curved form, concave on the cut side. Soft iron does not harden when suddenly cooled, but acquires increased rigidity and tensile strength; while cast iron, containing more carbon than steel, becomes under the same treatment extremely hard (chilled iron), often harder than steel. The freshly fractured surface of hardened steel shows a fine grain, often velvety in appearance; that of soft steel presents facets. In the former, analysis shows no uncombined carbon; in the latter, a small amount of graphite is almost always present. Steel expands on hardening, and loses specific gravity. Elsner found one sample to change in gravity from 7·9288 to

7·6578, and another from 8·0923 to 7·6578. Caron found a decrease from 7·817 to 7·743. The latter found that hammered steel on hardening lost in length and gained in other dimensions, while rolled steel gained in length. The effect of hardening on the tenacity of steel is discussed under Iron, and also further on in this article. Steel over-heated becomes brittle, and is said to be burnt. Whether this impaired cohesion is due to oxide of iron, or, as has been suggested, to carbonic oxide (either of which might be formed at high temperatures with access of air), or to a crystallization of the particles, is not certainly known. Many fluxes have been suggested for restoring burnt steel. They usually contain easily fusible substances, such as alkalies, borax, &c., combined with carbonaceous compounds, such as prussiate of potash. Hammering at a high heat is said to restore burnt steel.—The working of steel requires great skill and judgment. It cannot be wrought at very high temperatures; and the more carbon it contains, the lower must be the heat of working. The harder steels are generally hammered at a cherry-red heat. On the other hand, working at too low a temperature seriously impairs the tenacity of steel, as is abundantly shown by experience with steel rails. Welding steel to steel or steel to iron is difficult, except with the softest or least carburized varieties. Fluxes to facilitate such welding are largely used with good effect; they add nothing to the intimacy of the weld, their action being mechanical only (cleansing, exclusion of air, &c.), as in the case of iron welding. There is always danger of the separation of iron and steel at the weld, unless the latter is very soft. Special devices, such as causing one of the metals so welded to overlap and enclose the other, counteract this tendency in part. Or fluid steel may be cast directly around white-hot wrought iron, the weld being promoted by subsequent rolling or hammering. Sometimes the iron and steel to be welded are enclosed in a case of thin wrought iron and exposed to a welding heat, the enclosure preventing an access of air and oxidation of the surfaces of the metal.—*Strength of Steel.* The cohesive force of steel is usually considered under the different heads of absolute strength, or the force required to produce rupture; the elastic limit, or the least force by which a permanent alteration of form is effected; and the extensibility, or the amount of elongation under a breaking stress. The experimental data are referred, for convenience of comparison, to bars or rods of one square inch section. The above named properties are dependent, first, on the chemical composition of the metal; secondly, on its homogeneity; thirdly, on its molecular structure; and fourthly, on the temperature. (For comparison of the strength of cast iron, wrought iron, and steel, see Iron.) 1. The effect of the amount of carbon on the properties of steel is shown in the following tables compiled from Knut Styffe's work on the "Elasticity, Extensibility, and Tensile Strength of Iron and Steel:"

| PUDDLED STEEL—SQUARE BARS. | Breaking weight per sq. in. of original mean area, in lbs. | Breaking weight referred to area of fracture. |
|---|---|---|
| Hard steel, with 0·6 to 0·8 per cent. carbon | 89,189 | 122,240 |
| Middling hard, with 0·55 to 0·7 per cent. carbon | 80,628 | 115,670 |
| Soft steel, with less than 0·5 per cent. carbon | 70,272 | 112,593 |
| Puddled iron, with 0·2 per cent. carbon | 48,319 | 120,770 |

BESSEMER STEEL.

| CARBON, PER CENT. | Elastic limit. | Breaking weight per sq. in. of original area, in lbs. | Breaking weight, fractured area. | Elongation by rupture per cent. |
|---|---|---|---|---|
| 2·16 | 64,502 | 86,804 | 89,617 | 2·96 |
| 1·85 | 57,640 | 99,842 | 102,178 | 1·75 |
| 1·35 | 76,511 | 107,184 | 137,308 | 2·80 |
| 1·14 | 85,431 | 127,564 | 216,158 | 2·90 |
| 1·05 | 68,620 | 108,213 | 176,422 | 2·90 |
| 0·99 | 65,875 | 102,998 | 106,223 | 3·70 |
| 0·68 | 68,620 | 101,214 | 155,218 | 3·70 |
| 0·42 | ...... | 68,757 | 161,325 | 16·70 |
| 0·38 | 34,990 | 64,708 | 141,219 | 16·70 |
| .... | 41,251 | 68,268 | ...... | 24·50 |

The last sample was homogeneous iron prepared with ferro-manganese. To interpret correctly results like the above, it is necessary to eliminate all disturbing influences of composition and treatment. While these figures do not show a uniform change of properties with gradually increasing amounts of carbon, they nevertheless show decidedly that the effect of carbon on iron is to increase its absolute strength and elastic limit, and to decrease its extensibility. An increase of carbon beyond 1·2 per cent. is not accompanied, as a rule, by an increase in absolute strength. When reference is had to the fractured area, it will be seen that the force required to produce rupture does not differ as widely in different steels as when the original area alone is considered. The effect of melting, or in other words of the homogeneity of steel, is strikingly shown by a comparison of the two preceding tables, the former referring to puddled or welded steel, and the latter to Bessemer or homogeneous steel. The effect of molecular structure on the physical properties of steel has been partially treated under Iron. The table, vol. ix., p. 374, shows that the effect of hardening is to increase greatly the strength and elastic limit in steel, and to decrease its extensibility. The data given by J. Barba ("Memoir on the Uses of Steel") show that as the proportion of carbon decreases, the effect of sudden cooling becomes less marked, but even the softest iron is made somewhat more rigid by this treatment. The effect of hardening and tempering is, further, well shown by the following results of experiments on bars of steel cut from the same mass and submitted to a different treatment, made with reference

to the use of steel for the construction of the bridge over the Mississippi at St. Louis:

| CONDITION OF STEEL. | Tensile strength, lbs. per square inch. | Crushing strength, lbs. per square inch. |
|---|---|---|
| No. 1. In its original condition.......... | 109,473 to 131,864 | 100,080 to 112,400 |
| No. 2. Heated to bright red and cooled in oil at 78°..... | 201,341 to 227,542 | 173,200 to 199,200 |
| No. 3. Heated to bright red, hardened in water at 72°, and tempered at blue heat......... | 152,533 to 176,084 | 325,400 to 400,000 |
| No. 4. Heated to bright red and hardened in water at 72°............ | 132,659 to 150,480 | 275,640 to 381,680 |

—The change of molecular structure resulting from working steel when cold has lately demanded attentive consideration from engineers, owing to the increased use of steel for construction and for the permanent ways of railroads. All violent mechanical treatment of steel after it has become cold, such as rolling, hammering, punching, notching, &c., is found to impair its strength seriously. Sandberg has stated that the strength of steel rails notched on the flange was decreased from 50 to 97 per cent.; the former where the notch was semicircular, the latter where the notch was square. It is evident that this decrease of strength is not alone due to the removal of so much material, but that there must be a local tension of the particles which leads to rupture, and annealing is found to remove this tension. —The variety of opinions entertained by engineers as to the principal causes of fracture of steel rails is shown in the following summary of answers recently obtained from the administrations of 24 German railways in response to the request of a commission appointed to investigate this subject. The figures in parentheses indicate the number of administrations mentioning the prefixed cause. 1. The employment of too brittle metal (8). 2. Manufacture at too high temperature (2). 3. Rolling at too low temperature (3). 4. Cooling irregularly or too rapidly after rolling (5). 5. straightening cold, producing fissures which enlarge and result in fracture (15); producing a change of structure (1). 6. Notching the flange (14) (only two denied this cause). 7. Manner of piercing the holes (6). 8. Reduction of area of section of rails by the holes (1). 9. Bending the rails for laying on curves (3). 10. Rough handling of rails, such as throwing from cars to the ground, giving rise to fissures which result in fracture (9). It will be noticed that the majority of answers agree in attributing the fracture of rails to improper treatment of the steel when cold. The cause of the brittleness and impaired strength in steel and iron consequent upon punching has been investigated in Lorient, France, by J. Barba, who has found that cold punching induces a local hardening and tension of the metal, in a zone less than 0·04 in. wide, around the hole, and that when this hardened portion is filed or cut away, or softened and relaxed by annealing, the metal regains its original strength and extensibility. He thinks the hardening due to the combination of carbon and iron, as is also supposed to be the case when steel is hardened by heating and sudden cooling. Indeed, this heating and cooling is what undoubtedly occurs to the immediately adjacent metal in punching. The diminished strength of punched plates is caused by this narrow hardened portion, which, owing to its decreased extensibility, receives the full effect of the stress, a rupture being produced in this portion and then extending throughout the whole mass of metal. The same effect, in an enhanced degree, would follow blows or shocks. The following are among the results obtained by Barba:

TERRE NOIRE BESSEMER STEEL.

| SIZE AND CHARACTER OF HOLE. | TENSILE STRENGTH IN TONS PER SQ. IN. | |
|---|---|---|
| | Bar 1·96 in. wide. | Bar 1·771 in. wide. |
| Cylindrical hole punched, 0·669 in....... | 25·86 | 27·76 |
| Hole enlarged to 0·774 in................ | 32·20 | ..... |
| Cylindrical hole drilled, 0·669 in........ | ...... | 34·61 |
| Cylindrical hole punched, 0·590 in., enlarged to 0·669 in..................... | ...... | 33·98 |

The effect of annealing after punching is shown in the following:

| CHARACTER OF BAR. | Tensile strength in tons per sq. in. |
|---|---|
| Punched bar.............................. | 24·47 |
| " " annealed...................... | 29·48 |
| Drilled bar.............................. | 29·98 |
| Punched, enlarged, and annealed............ | 30·30 |

The effect of temperature on the strength of steel has already been considered under IRON. More recently Joule has experimented on the tensile strength of steel bars, and confirms the result of previous investigations, that the tensile strength is not impaired by reduction of temperature. In determining the effect of blows at reduced temperatures, he experimented on cast-iron nails, and found that as many nails broke at ordinary as at freezing temperatures when exposed to a falling weight. These results must not be regarded as contradicting those of Sandberg on iron rails, nor does it follow that the same effect would have been produced had steel bars been used instead of cast iron.—*Uses of Steel.* The industrial applications of steel, formerly confined mainly to tools, weapons, and springs, have been widely extended since the introduction of the Bessemer and Martin processes. Among the principal modern uses of steel are rails, boilers, machinery, bridge construction, and ship building. The fact must not be overlooked that the term steel is now generally applied to all homogeneous, malleable compounds of iron, and includes products of all degrees of hard-

ness and rigidity. The adoption of steel for any particular purpose must, therefore, be intelligently based on its composition, structure, and treatment.—*Production of Steel in the United States.* The following statistics are compiled from the report of the secretary of the American iron and steel association, of January, 1875:

PRODUCTION BY YEARS IN NET TONS.

| YEARS. | Bessemer steel. | Other steel. |
|---|---|---|
| 1865 | ...... | 15,262 |
| 1866 | ...... | 18,973 |
| 1867 | 3,000 | 19,000 |
| 1868 | 8,500 | 21,500 |
| 1869 | 12,000 | 23,000 |
| 1870 | 40,000 | 35,000 |
| 1871 | 45,000 | 37,000 |
| 1872 | 110,500 | 38,000 |
| 1873 | 157,000 | 50,000 |
| 1874 | 176,579 | 47,481 |

Of the Bessemer production there was made into rails: in 1872, 94,070 tons; 1873, 129,015; 1874, 144,944. The importations of Bessemer rails for three years were 149,786, 159,571, and 100,486 tons, valued at $8,207,013, $8,984,103, and $6,838,875, gold, respectively. The average price in currency at which American steel rails have been sold at the works since the establishment of the industry is as follows: 1867, $160; 1868, $158½; 1869, $132¼; 1870, $106¾; 1871, $102½; 1872, $112; 1873, $120½; 1874, $94¼; 1875, $75. Of the steel other than Bessemer produced in 1874, 34,128 tons was crucible steel, the remainder puddled, open hearth, and blister steel.

**STEEL, Dephosphorization of.** See p. 897.

**STEELE**, a S. E. county of Minnesota, drained by the Lester river and branches of Cannon river; area, 432 sq. m.; pop. in 1870, 8,271. The surface is undulating, and the soil fertile. There are three or four small lakes and several fine streams. The chief productions in 1870 were 385,214 bushels of wheat, 82,040 of Indian corn, 230,421 of oats, 12,709 of barley, 36,025 of potatoes, 19,928 tons of hay, 7,172 lbs. of wool, 208,249 of butter, and 8,700 of hops. There were 1,971 horses, 2,846 milch cows, 3,794 other cattle, 2,785 sheep, and 2,006 swine. The Chicago, Milwaukee, and St. Paul, and the Chicago and Northwestern railroads pass through the capital, Owatonna.

**STEELE, Sir Richard**, a British author, born in Dublin in 1671, died at Llangunnor, near Carmarthen, Wales, Sept. 1, 1729. He received his early education at the Charterhouse, where his intimacy with Addison was formed. In 1691 he entered Merton college, Oxford, but left at the expiration of three years without taking a degree, enlisted as a private in the horse guards, and reached the rank of captain in Lucas's fusileers, an appointment due to his colonel, Lord Cutts, to whom he had dedicated "The Christian Hero" (1701). In odd contrast with this work was his comedy of "The Funeral, or Grief à la Mode" (1702), which was followed by "The Tender Husband" (1703), and "The Lying Lover" (1704). He was appointed "gazetteer" and gentleman usher to Prince George of Denmark, and derived ample means from two wealthy marriages (the last in 1707), but was always in pecuniary trouble through reckless expenditure and dissipation, his life being passed, as he says, in "sinning and repenting." In 1709 he commenced the "Tatler," for which Addison furnished many of the leading papers, though by no means so many as Steele, whom he now assisted to the appointment of a commissioner of the stamp office. With the overthrow of the whigs in 1710 he lost his office of gazetteer, and with it the means of supplying the items of official news which at first formed an important feature in the "Tatler." This paper was accordingly succeeded in 1711 by the "Spectator," written chiefly by Steele and Addison, and subsequently by the "Guardian," begun and ended in 1713, and the "Lover," the "Reader," and other periodicals which had but a brief existence. In 1713 Steele resigned his office, and was returned to parliament from Stockbridge in Hampshire; but for writing articles in the "Crisis" and the "Englishman," adjudged to have been libels against her majesty's administration, he was expelled by a vote of 245 to 152. His pen, however, continued to be actively employed in the whig interest, and on the accession of George I. he received several profitable appointments, was knighted, and elected to parliament from Boroughbridge. In 1722 he produced his last and best comedy, "The Conscious Lovers," which proved completely successful, and brought him in ample receipts; but he was soon reduced to straits again. A paralytic attack rendered him incapable of further literary labor, and he retired to a small estate near Carmarthen left him by his second wife, where he died almost forgotten by his contemporaries. He first conceived the characters of Sir Roger de Coverley, Will Honeycomb, and others of the Spectator club, which received their finishing touches from the hand of Addison. His letters to his wife, about 400 in number, form one of the most singular correspondences ever published.—There is an elaborate treatise on the character and genius of Steele in Forster's "Historical and Biographical Essays;" and Thackeray, in his "Lectures on the English Humorists," has treated the same subject at length. See also "Memoirs of the Life and Writings of Sir Richard Steele," with his correspondence, by H. R. Montgomery (2 vols. 8vo, London, 1865).

**STEEL ENGRAVING.** See ENGRAVING.

**STEELL, Sir John.** See p. 898.

**STEELYARD.** See BALANCE.

**STEEN, Jan**, a Dutch painter, born in Leyden in 1636, died in Delft in 1689. He studied under Brouwer and Van Goyen, whose daughter he married. According to Kugler, he brought into full play all the elements of genuine low comedy. In the museum at the Hague

is his well known "Representation of Human Life." He painted in all about 300 pictures. —See *J. Steen, Étude sur l'art en Hollande*, by Van Westrheenen (the Hague, 1856).

**STEERING APPARATUS,** the appliances by which vessels are guided through the water. The earliest method was by a long oar passed out of the stern. An oar is a very efficient means of steering boats, and is still employed on whale boats, rafts, &c. The rudder governs a ship's motion by being turned so that its plane is in a position oblique to the plane of the masts and keel, and the reaction of the water against it causes the ship to turn. The head of the rudder, projecting above the deck, is furnished with a horizontal handle or lever called the tiller, by which the rudder is turned. The term helm is often applied to this, as also to the rudder and tiller together. To keep the rudder in the desired position against the force of the waves, on small vessels a rope is made fast on the weather side by one end, while the other is held with a turn around the tiller. A block and tackle are required for larger vessels, replaced upon still larger ones by "the wheel." This is a wheel and axle set upon the tiller, the rope of which, making several turns round the axle, is carried toward each side of the ship, so that the turning of the axle draws the tiller toward that side the rope of which is being wound up. The handles for working the wheel appear as spokes extending beyond the periphery. On river steamers, to enable the steersman (in this case called a pilot) to guide the vessel from his own observation, the wheel is placed within a structure called the pilot house on the upper deck at the forward end, and connected with the rudder. For this purpose ropes were formerly used, but serious disasters having occurred from their being burned in case of fire, it is now a law in the United States that chains or iron rods shall be used. By the use of two screw propellers, one each side the rudder, it was found by Mr. Edwin A. Stevens of Hoboken, N. J., that when these are worked in opposite directions the vessel may be turned on its centre as a pivot; he adopted this plan for the "Stevens battery."

**STEEVENS, George,** an English editor, born at Stepney, May 10, 1736, died at Hampstead, Jan. 22, 1800. He was educated at Eton and Cambridge. His first publication, a reprint of "Twenty of the Plays of Shakespeare, being the whole Number printed in Quarto during his Lifetime" (4 vols. 8vo, 1766), contained in foot notes a variety of readings from other quarto editions. The reputation which he thereby acquired led to his association with Johnson in the preparation of the edition of Shakespeare published in 1773 with their joint names. Their second edition appeared in 1778, and in 1780 Malone, who had assisted Johnson and Steevens, published a supplement containing the doubtful plays and the poems. Steevens, associated with Isaac Reed, in the next twelve years prepared two new editions (10 vols. 8vo, 1785, and 15 vols., 1793), in which, "instead of a timid and servile adherence to ancient copies," he undertook the "expulsion of useless and supernumerary syllables, and an occasional supply of such as might fortuitously have been omitted." The text of these editions remained the standard for nearly 50 years.

**STEFFENS, Heinrich,** a German author, born in Stavanger, Norway, May 2, 1773, died in Berlin, Feb. 13, 1845. He studied theology and the natural sciences at Copenhagen, and afterward at Jena became a disciple of Schelling. After returning to Copenhagen he engaged, under the auspices of Werner at Freiberg, in geological labors. He was professor at Halle from 1804 to 1807, and again from 1809 to 1811, and subsequently at Breslau (except during his service in the army in 1814-'15) till 1831, when he was transferred to Berlin. He was associated with the principal philosophers and poets of his day, and also with Schleiermacher, and became known in theology first as a dissenter from and finally as an adherent of the strict doctrines of the old Lutherans. He excelled as a poetical and miscellaneous writer, but his reputation rests on his philosophical labors, in which, according to Michelet, "he most manifestly set forth the totality of the school of Schelling." His works include *Recension von Schelling's naturphilosophischen Schriften* (Jena, 1800); *Grundzüge der philosophischen Naturwissenschaft* (Berlin, 1806); *Handbuch der Oryktognosie* (3 vols., Halle, 1811 -'19); *Caricaturen des Heiligsten* (2 vols., Leipsic, 1819-'21); *Anthropologie* (2 vols., Breslau, 1822); *Von der falschen Theologie und dem wahren Glauben* (1824; new ed., 1831); *Wie ich wieder Lutheraner wurde und was mir das Lutherthum ist* (1831); *Novellen* (16 vols., 1837-'8); and *Was ich erlebte* (10 vols., 1840-'45; 2d ed., 1844-'6; abridged English translation by W. L. Gage, "The Story of my Career as Student at Freiberg and Jena," Boston, 1863; republished under the title "German University Life," Philadelphia, 1874).

**STEIN, Karl,** baron. See ALTENSTEIN.

**STEIN, Heinrich Friedrich Karl,** baron, a German statesman, born at Nassau, Oct. 26, 1757, died at Frücht, near Nassau, June 29, 1831. He studied at Göttingen, and rose to distinction in the department of mines in Westphalia. In 1804 he was chief of an economico-commercial department in the Prussian ministry of the interior, and abolished restrictions on trade and introduced other reforms. Foreseeing the calamities of Prussia, he urged in vain the union of all the German states. This made him uncongenial to Frederick William III., who removed him in January, 1807. But he was soon reinstated, and in July placed at the head of the ministry. He reorganized the whole civil service, abolished feudal usages, adopted a new scheme of militia, and opened the way for the Zollverein and the present unity of Germany. Napoleon, after favoring

Stein's accession, became in 1808 embittered against him on account of an intercepted letter in which the Prussian minister expressed a hope for his speedy downfall. Stein was obliged to leave the cabinet in November, and Napoleon outlawed him in December, and confiscated his property. He sought refuge in Austria, and in May, 1812, with the emperor Alexander in Russia. At the end of 1813, after the capture of Dresden by the allies, he was placed at the head of the council for the administration of the reconquered German territories, and exerted much influence on the memorable events of 1814–'15. In 1819 he formed a society for investigating early German history, and he promoted the publication of the celebrated *Monumenta Germaniæ Historica*. In 1827 he became a member of the Prussian council of state.—Pertz has edited *Denkschriften des Freiherrn vom Stein* (Berlin, 1828), and published *Das Leben des Ministers Freiherrn vom Stein* (6 vols., 1849–'55; abridged ed., *Aus Stein's Leben*, 2 vols., 1856). See also Stern, *Stein und sein Zeitalter* (Leipsic, 1855); Venedey, *Heinrich Friedrich Karl vom Stein* (Iserlohn, 1868); and Arndt, *Meine Wanderungen und Wandlungen mit dem Reichsfreiherrn vom Stein* (Berlin, 1858; 3d ed., 1870). Monuments were erected to him at Nassau in 1872, and in Berlin in 1875.

**STEIN, Charlotte Albertine Ernestine von**, a German baroness, born in Weimar, Dec. 25, 1742, died there, Jan. 6, 1827. She was a daughter of a marshal of the grand ducal court, and in 1764 married the baron Friedrich von Stein, to whom she bore seven children, and who died in 1793. She became intimate with Goethe soon after his first arrival at Weimar in 1775. In 1788, shortly after his return from Italy and the beginning of his liaison with his future wife Christiane Vulpius, Goethe broke off his relations with Frau von Stein, though she continued to exercise much influence upon his mind. Her tragedy *Dido*, edited by H. Düntzer (Leipsic, 1867), refers to Goethe and his Weimar contemporaries. A. Schott has edited Goethe's letters to her, excepting those from Italy (3 vols., Weimar, 1848–'51), and those addressed by him and his mother to Frau von Stein's son appeared in 1846. Her correspondence with Schiller's wife is contained in *Charlotte von Schiller und ihre Freunde* (2 vols., Stuttgart, 1865). See also *Charlotte von Stein*, by H. Düntzer (2 vols., 1874).

**STEIN, Lorenz**, a German political economist, born in Eckernförde, Schleswig, Nov. 15, 1815. He became professor at Kiel in 1846, was prominent in the movement for the independence of the duchies, represented the provisional government of Schleswig-Holstein at Paris in 1848, and was removed from his professorship in 1852. In 1855 he became professor of political sciences at Vienna. His works include *Französiche Staats- und Rechtsgeschichte* (3 vols., Basel, 1846–'8); *Geschichte der socialen Bewegung in Frankreich von 1789 bis auf unsere Tage* (new ed., 3 vols., Leipsic, 1849–'51); *System der Staatswissenschaften* (2 vols., Stuttgart, 1852–'6); *Lehrbuch der Finanzwissenschaft* (Leipsic, 1860; 2d ed., 1871); *Die Verwaltungslehre* (4 vols., Stuttgart, 1865–'8); *Die Lehre vom Heerwesen* (1874); and *Gegenwart und Zukunft der Rechts- und Staatswissenschaft Deutschlands* (1875).

**STEINBOCK.** See IBEX.

**STEINLE, Johann Eduard**, a German painter, born in Vienna in 1810. He studied in Munich, worked in Rome under Overbeck's direction, and painted in fresco "The Sermon on the Mount" in the chapel of Rheineck, the "Chorus of Angels" in the Cologne cathedral (1843), and the "Judgment of Solomon" in the Römer at Frankfort (1844). In 1850 he was appointed professor at the Städel institute. His subsequent works include "Christ as the Good Shepherd" and "The Lost Son."

**STEINTHAL, Heymann**, a German philologist, born of Jewish parents at Gröbzig, Anhalt, May 16, 1823. He studied in Berlin, and became a lecturer there on language and mythology. In 1852 he went to Paris to study Chinese, and in 1863 returned to Berlin as professor extraordinary. Besides editing with Lazarus the *Zeitschrift für Völkerpsychologie und Sprachwissenschaft* (Berlin, 1859 *et seq.*), he has published *Die Classification der Sprachen* (Berlin, 1850); *Der Ursprung der Sprache* (1851); *Die Entwickelung der Schrift* (1852); *Das gegenseitige Verhältniss der Grammatik, Logik und Psychologie* (1855); *Geschichte der Sprachwissenschaft bei den Griechen* (1863); *Die Mande-Negersprachen* (1867); and *Abriss der Sprachwissenschaft* (1871 *et seq.*).

**STELLIO** (Daud.), a genus of iguanian lizards, characterized by a triangular, flattened head, covered with numerous small spinous plates; body depressed, the scales having intermixed some larger and rougher plates; a longitudinal fold on each side between the legs; no femoral pores, and no dorsal or caudal crest; anal pores distinct; tail with large keeled and spiny scales arranged in whorls; incisors four above, canines two above and none below, and cheek teeth triangular; no teeth on palate; tongue thick and fleshy. The common stellio (*S. vulgaris*, Daud.), the *lacerta stellio* of Linnæus, the *hardun* of the Arabs, is about a foot long, of which the tail is not quite one half; the color is olive, shaded and spotted with black above and olive yellow below. It is common in the Levant, and especially in Egypt, where its excrements were formerly collected and used in making cosmetics; it is very active, feeding on insects, and living in ruins, clefts of rocks, and holes in the ground. The *stellio* of the ancients was a species of gecko, and probably the *ptyodactylus Hasselquistii* (Dum. and Bibr.). (See GECKO.)

**STENDHAL.** See BEYLE.

**STENO, Nicolas**, a Danish anatomist, born in Copenhagen in 1638, died in 1686. He studied medicine at Copenhagen and afterward at Ley-

den, where he graduated in 1664. Very early in his professional life he discovered the existence, course, and office of the excretory duct of the parotid gland, since known as "Steno's duct." He acquired reputation by his anatomical writings, became physician to the grand duke of Tuscany, and afterward professor of anatomy at Copenhagen. Returning to Florence, he became a Catholic in 1669 and a priest in 1677, and was for the rest of his life a missionary with the title of apostolic vicar of the see of Rome for all the north.

**STENOGRAPHY**, a method of abbreviating ordinary writing by the use of signs, now almost universally superseded by phonography or phonetic shorthand. (See PHONOGRAPHY.)

**STENTOR**, a Grecian herald in the Trojan war, from whose name is derived the word stentorian. Homer describes him as "great-hearted, brazen-voiced Stentor, who shouted as loud as fifty other men."

**STEPHEN** (Gr. *στέφανος*, a crown), **Saint**, the first martyr of the Christian church. He was a Hellenist by birth, and one of the seven deacons in the Christian congregation of Jerusalem, who, upon the complaint of the Hellenists that their widows were neglected, had been chosen by order of the apostles to superintend everything connected with the relief of the poor. The Jews charged him with speaking against the law and the temple, against Moses, and against God, and by order of the sanhedrim he was stoned. (Acts vi. and vii.) His death is believed to have happened in the year 36 or 37. His feast has been celebrated in the eastern and western churches on Dec. 26 since the 4th century.

**STEPHEN**, the name of ten popes, of whom the following are most important. **I. Stephen I., Saint**, born in Rome about 200, died there in 257 (according to some authorities in 260). He was elected in 253 (or 257). His pontificate is remarkable for his having deposed, at the instance of St. Cyprian, the Novatian Marcianus, bishop of Arles, for having reversed the sentence of a Spanish synod deposing two bishops accused of apostasy; and for a memorable controversy with St. Cyprian relating to the necessity of rebaptizing converted heretics. Only fragments of Stephen's epistles are extant. He was put to death during the persecution of Valerian. **II. Stephen III.** (called by French historians Stephen II.), born in Rome about 690, died there in April, 757. He was educated in the school of St. John Lateran, and was a canon regular of that basilica when he was chosen pope, in March, 752, as successor of Stephen II., who died three days after his election, without having received episcopal consecration. Stephen III., immediately after his accession, opposed Astolphus, king of the Lombards, who had possessed himself of Ravenna and its dependent provinces, and demanded the surrender of Rome and its territory. Having for a year vainly sought the armed intervention of the Greek emperor Constantine V., the pope went to Pavia in October, 753, to conciliate Astolphus, and thence to Pontyon in Champagne, in January, 754, where he implored the protection of Pepin, king of the Franks. During Eastertide an assembly was held at Quercy-sur-Oise, at which Pepin and his nobles pledged themselves to defend the pope, and the latter gave a series of decisions relating to matrimony and church government. In July he consecrated the abbey church of St. Denis near Paris, and anointed and crowned Pepin and his sons Carloman and Charles (afterward Charlemagne), and returned to Italy with Pepin and a powerful army. Astolphus was forced to give up the exarchate of Ravenna; but after the departure of Pepin in December he reoccupied these territories and besieged Stephen in Rome. Pepin recrossed the Alps early in 755, defeated Astolphus, and compelled him by treaty to make over the exarchate to the pope. This treaty, which was signed by Pepin, his sons, and the chief Frankish barons and prelates, assigned the reconquered provinces as a gift "to the blessed Peter, the holy church of God, and the Roman republic," and inaugurated the temporalities of the Roman see. In 756 Desiderius, the successor of Astolphus, ratified this treaty as a condition to his being recognized by Stephen and Pepin. The literary remains of Stephen III. consist of important letters contained in the *Codex Carolinus*, and of his *Responsa ad Gallos*, in Labbe's *Concilia*. **III. Stephen X.** (Frederick of Lorraine), born about 1000, died in Florence in 1058. He was brother to Godfrey of Lorraine, duke of Tuscany. Pope Leo IX. made him a cardinal, and in 1054 sent him as legate to Constantinople. On his return in 1055, his life being threatened by the emperor Henry III., he fled to Monte Casino, and became a Benedictine monk in that monastery, and in May, 1057, its abbot. He was made cardinal priest by Pope Victor II., in whose place he was elected in August, 1057, by the influence of Cardinal Hildebrand (afterward Pope Gregory VII.). He held several councils in Rome for the enforcement of sacerdotal celibacy, and degraded all incontinent clerics who had violated the statutes of Pope Leo IX. He visited Monte Casino, caused an abbot to be elected in his own place, compelled the monks to reform all abuses incompatible with their vow of poverty, and created Pietro Damiani cardinal. He issued the most rigorous decrees against simony, but maintained the exemption of clergymen from trial by lay judges, and from being taxed without the authorization of the holy see.

**STEPHEN**, king of England, the fourth and last of the Anglo-Norman line, born about 1100, died Oct. 25, 1154. His father was Stephen, count of Blois, and his mother was Adela or Adelicia, the fourth or fifth daughter of William the Conqueror; and Stephen was their third son and sixth child. He early be-

came a favorite of Henry I., his maternal uncle, who knighted him in his youth, and gave him the earldom of Mortagne in Normandy and several valuable estates in England. Henry procured his marriage to Matilda, heiress to the count of Boulogne, as early as 1114, by which Stephen became possessed of that title and property. When, in 1120, William, the heir of Henry I., and so many other members of the king's family and household, were lost by the foundering of the White ship, Stephen had been saved from the same fate by leaving the vessel on finding that she was too crowded for safety. Stephen with other nobles took the oath to support Henry's daughter the empress Matilda as queen of England and duchess of Normandy, should her father die without issue male; but her subsequent marriage with Geoffrey Plantagenet, count of Anjou, in violation of the king's assurance, was thought to have cancelled the obligation. Theobald, count of Blois, Stephen's eldest brother, was regarded by many Normans as the proper person to succeed Henry; but while they were deliberating, Stephen hastened to England, and was crowned in December, 1135. He confirmed to the English the immunities and laws of Henry I., and also the laws and customs of Edward the Confessor. He secured peace with Scotland by making cessions to King David, from whom he obtained acknowledgment and homage. At a meeting of barons and prelates at Oxford, he produced a letter from the pope approving his election to the throne. A charter was framed, by which the old privileges of all classes were confirmed, and certain abuses of the preceding reign were removed. The reign of Stephen was a period of constant war and tumult. He was involved in contests with the Welsh, who inflicted defeat and loss on the English. In the war that was renewed with Scotland in 1138, the English gained the great battle of the standard, Aug. 22. Revolts broke out, at different times, in various parts of the country. The cause of the empress Matilda was early taken up by a party in England, headed by her natural brother Robert, earl of Gloucester; and on Sept. 30, 1139, Matilda landed in England. Stephen was defeated and made prisoner, Feb. 2, 1141, at the battle of Lincoln. The greater portion of the country submitted to the victors; but Matilda's arrogance was so offensive that a reaction speedily took place. Her brother was defeated and captured in September, 1141, and was exchanged for Stephen. At the battle of Wilton, July 1, 1143, Gloucester was victorious, and the king preserved his freedom only by flight. The war raged for years, and the condition of England was made most deplorable. In 1153 Henry, son of Matilda, arrived in England at the head of a considerable force, and defeated Stephen at Malmesbury; but leading men on both sides now interposed to bring about a peace, which was facilitated by the sudden death of the king's eldest son, Eustace. By the treaty of Winchester, Nov. 7, 1153, it was settled that Stephen should remain king of England for life, and that he should be succeeded by Henry; and that Stephen's son William should retain all his possessions acquired by marriage or otherwise, and all those which his father had held in Normandy, England, and elsewhere, before he became king. Stephen did not survive the making of this treaty quite one year. His reign was the most miserable time ever known in England. The country was covered with castles, many hundreds of which were erected at this period; and it was devastated by the foreign soldiery, the king himself employing numerous mercenaries, principally from Flanders and Brittany. The throne passed on his death to the house of Plantagenet in the person of Henry II.

**STEPHEN I., Saint**, king of Hungary. See Hungary, vol. ix., p. 55.

**STEPHEN**, king of Poland. See Báthori, and Poland, vol. xiii., p. 646.

**STEPHEN. I. Sir James**, an English statesman, born in London, Jan. 3, 1789, died in Coblentz, Sept. 15, 1859. He graduated at Cambridge in 1812, and was called to the bar at Lincoln's Inn. He was appointed counsel in the colonial department of the public service, and in 1824 counsel to the board of trade. In 1834 he was made assistant and subsequently permanent under-secretary, and retired from office in 1847, when he was knighted. From 1849 till his death he was regius professor of modern history in the university of Cambridge. He published "Essays in Ecclesiastical Biography and other Subjects" (2 vols. 8vo, London, 1849; 4th ed., with a biographical notice by his son, 1860), and "Lectures on the History of France" (2 vols. 8vo, 1851). **II. James Fitzjames**, an English jurist, son of the preceding, born in March, 1829. He graduated at Cambridge in 1852, was called to the bar in 1854, and was legal adviser to the government in India from December, 1869, to April, 1872, when he returned to London. He has published "General View of the Criminal Law of England" (8vo, 1863); "Definition of Murder Considered" (1866); and "Liberty, Equality, Fraternity" (1873). "Essays by a Barrister," reprinted from the "Saturday Review" in 1862, is attributed to him.

**STEPHENS**, an unorganized N. W. county of Texas, intersected in the north by the Clear fork of Brazos river; area, 900 sq. m.; pop. in 1870, 330, of whom 24 were colored. The surface is diversified with hills and valleys, creeks and springs. Stock raising is the chief occupation. The bottom lands of Hubbard's creek are rich.

**STEPHENS**, or **Stephanus** (Fr. *Estienne* or *Étienne*), the name of a French family of printers who flourished during the 16th and 17th centuries. Henry, the founder of the family (born about 1465, died about 1520), established a printing house in Paris in 1502. He published mathematical and theological works,

distinguished for their accuracy. His sons, FRANÇOIS (1502–'50), ROBERT I. (born in Paris in 1503, died in Geneva in 1559), and CHARLES (born in Paris about 1505, died in 1564), were largely engaged in printing. Robert, a man of great learning and industry, in his 20th year published an edition of the Latin New Testament, with some corrections by himself. At his house, which was the resort of the most eminent literary men, Latin was the ordinary language of conversation, even among the children and servants, to whom it was taught by his wife. For many years scarcely a month passed in which some work, generally edited and corrected by himself, did not issue from his press. He is said to have publicly posted proof sheets of his works, with the offer of a premium for the detection of errors. In 1531 he began the publication of his *Dictionarium, seu Thesaurus Linguæ Latinæ*, which he improved in two subsequent editions. New editions have appeared in the present century at London (8 vols. fol., 1815–'25) and Paris (9 vols. fol., 1829–'63). His editions of the Bible with notes brought him into trouble with the Sorbonne, from which he was protected during the life of Francis I., who had appointed him royal printer. After the king's death the Sorbonne caused the sale of his Bibles to be prohibited, and to insure his safety the printer retired to Geneva, where he died, it is said, in the Calvinistic faith. He published at least 11 complete editions of the Bible, in Hebrew, Greek, Latin, and French, besides many separate editions of the New Testament; and 382 other works, mostly of the first importance, came from his press. He first introduced the existing division of the New Testament into verses. Charles, the younger brother of Robert, devoted himself to physical sciences, and for some years practised medicine. He succeeded to his brother's business when the latter retired to Geneva, and was subsequently appointed printer to Henry II. His publications, scientific and classical, are numerous.—HENRY, son of Robert (born in Paris in 1528, died in 1598), spoke Latin with fluency while a child, and throughout his life was a profound student of Greek literature. His establishments were successively in Paris and Geneva; but after the publication of his *Thesaurus Linguæ Græcæ*, the costliness of which confined it to a limited number of purchasers and involved the printer in pecuniary embarrassments, he travelled from city to city, exploring libraries, and collecting an immense amount of material for works which he was projecting, and which he published wherever he happened to be. Among the best known of them are: *Conformité du langage françois avec le grec* (Geneva, about 1565; latest ed., with a notice of his life by Léon Feugère, Paris, 1853), and *La précellence du langage françois* (Paris, 1579; latest ed., with an essay on him and notes by the same author, 1851).—Among others of the family were PAUL, son of the preceding (born in Geneva in 1566, died there in 1627), who succeeded his father in the printing establishment at Geneva, which he conducted for many years; and ANTHONY, his son (born in Geneva about 1592, died at the Hôtel-Dieu in Paris in 1674), who for 50 years conducted a printing house in Paris, but died in great poverty.—See A. A. Renouard, *Annales de l'imprimerie des Estienne* (Paris, 1837; 2d ed., 1843).

**STEPHENS, Alexander Hamilton**, an American statesman, born in Taliaferro co., Ga., Feb. 11, 1812. He graduated at Franklin college, Athens, Ga., in 1832, was admitted to the bar in 1834, and rapidly obtained a large and lucrative practice at Crawfordville. He was elected to the legislature of Georgia in 1836, and was reëlected for five successive terms. In 1842 he was elected to the state senate. In 1843 he was elected as a whig to congress, and held his seat till 1859. In February, 1847, he submitted a series of resolutions in relation to the Mexican war, which afterward formed the platform of the whig party. He opposed the Clayton compromise in 1848, and took a leading part in the compromises of 1850. The passage of the Kansas and Nebraska act of 1854 in the house of representatives was strongly supported by him as chairman of the committee on territories. After the breaking up of the whig party he acted with the democrats. At the close of the 35th congress Mr. Stephens declined to be again a candidate, and on July 2, 1859, he made a speech at Augusta, Ga., announcing his retirement from public life. During the presidential canvass of 1860 he sustained Douglas, and denounced those who advocated a dissolution of the Union in case of Mr. Lincoln's election; and in November, 1860, he made a speech before the legislature of Georgia against secession, on which subject he had an interesting correspondence with Mr. Lincoln in December. He was nevertheless elected to the secession convention which met at Milledgeville, Jan. 16, 1861, and there spoke and voted against the secession ordinance. He was a member of the southern congress which met in Montgomery, Ala., in February, and was elected vice president of the confederacy. On March 21 he delivered a speech in Savannah, in which he declared slavery to be the corner stone of the new government. (See CONFEDERATE STATES.) On April 23, as a special commissioner from the Confederate States, he addressed the convention at Richmond, urging the union of Virginia with the confederacy. He frequently differed from the policy of the Richmond government, especially on the subject of martial law; and on Sept. 8, 1862, he pronounced the appointment by Gen. Bragg of James M. Calhoun as civil governor of Atlanta a palpable usurpation. His letter on this subject created a marked sensation through the south. On Feb. 3, 1865, with R. M. T. Hunter and John A. Campbell, he held an informal conference on a steamer in Hampton roads with Presi-

dent Lincoln and Mr. Seward, which had no practical result. After Lee's surrender Stephens returned to his home in Crawfordville, where on May 11, 1865, he was arrested and sent to Fort Warren in Boston harbor; but on Oct. 11 he was released on parole. On Feb. 22, 1866, he delivered a speech before the legislature of Georgia favoring the restoration policy of President Johnson. In the same month he was elected to the United States senate, but as the state had not complied with the conditions of reconstruction, he was not permitted to take his seat. In 1872 he was elected to congress, and again in 1874, almost without opposition. He has published "A Constitutional View of the Late War between the States, its Causes, Character, Conduct, and Results" (2 vols. 8vo, Philadelphia, 1868-'70), and several speeches.—See "Alexander H. Stephens, in Public and Private," with his letters and speeches before, during, and since the war, by Henry Cleveland (8vo, Philadelphia, 1867).

**STEPHENS, Ann Sophia** (Winterbotham), an American authoress, born in Derby, Conn., in 1813. In 1832 she married Edward Stephens, a printer of Plymouth, Mass., in 1835-'7 edited the "Portland Magazine" and in 1836 the "Portland Sketch Book," and in 1837 removed to New York. She has since edited and contributed to various periodicals, and published many novels, one of the best known of which is "Fashion and Famine" (1854), which appeared in three French versions. A uniform edition of her works was published in Philadelphia in 1869 (14 vols. 12mo). Among her later novels are "Wives and Widows" (1869); "Married in Haste" (1870); "A Noble Woman" (1871); "The Reigning Belle" (1872); "Bellehood and Bondage" (1873); "Lord Hope's Choice," and its sequel, "The Old Countess" (1873); and "Phemie Frost's Experiences" (1874).

**STEPHENS, John Lloyd**, an American author, born in Shrewsbury, N. J., Nov. 28, 1805, died in New York, Oct. 10, 1852. He graduated at Columbia college in 1822, studied law, and practised in New York. After spending two years in travel, he published "Incidents of Travel in Egypt, Arabia Petræa, and the Holy Land" (2 vols. 12mo, 1837), and "Incidents of Travel in Greece, Turkey, Russia, and Poland" (2 vols. 12mo, 1838). He was appointed minister to Central America in 1839, explored the ancient remains of that country, and published "Incidents of Travel in Central America, Chiapas, and Yucatan" (2 vols. 8vo, New York, 1841). In 1842 he again visited Yucatan, and published "Incidents of Travel in Yucatan" (2 vols. 8vo, 1843). These works were illustrated by his fellow traveller Frederick Catherwood of London, and are valuable contributions to American antiquities. Mr. Stephens was active in establishing the first American line of transatlantic steamships. As vice president of the Panama railroad company he negotiated in 1849 the contract with the government of New Granada, was chosen president of the company, and superintended the construction of the road till his death.

**STEPHENSON**, a N. W. county of Illinois, bordering on Wisconsin, intersected by the Pecatonica river and several railroads; area, 550 sq. m.; pop. in 1870, 30,608. The surface is undulating and the soil fertile. The chief productions in 1870 were 529,513 bushels of wheat, 135,362 of rye, 1,615,679 of Indian corn, 960,620 of oats, 165,266 of barley, 261,-110 of potatoes, 36,507 tons of hay, 87,803 lbs. of tobacco, 69,251 of wool, 757,458 of butter, 30,976 of cheese, and 10,855 gallons of sorghum molasses. There were 11,441 horses, 10,723 milch cows, 15,186 other cattle, 18,348 sheep, and 34,437 swine; 14 manufactories of carriages and wagons, 1 of agricultural implements, 3 of furniture, 3 of iron castings, 8 of saddlery and harness, 3 of woollen goods, 3 breweries, and 1 tannery. Capital, Freeport.

**STEPHENSON. I. George**, an English railway engineer, born at Wylam, Northumberland, June 9, 1781, died at Tapton park, near Chesterfield, Derbyshire, Aug. 12, 1848. For several years he was employed at various collieries as fireman, and afterward as plugman, and gradually acquired so complete a knowledge of the engine as to be able to take it apart and make any ordinary repairs. At 18 he could not read; but within two years, by attending night schools, he was able to read, write, and cipher with tolerable facility. In 1805 he removed to Killingworth colliery, and about this time was desirous of emigrating to the United States, but was unable to raise money for his passage and outfit. He continued to work in different collieries, and in his leisure hours studied mechanics and engineering, mended clocks and shoes, cut out clothes for the miners, and turned his hand to other useful occupations. His skill in repairing engines and his improvements upon old machinery led in 1812 to his appointment as enginewright at Killingworth, at a salary of £100 a year. Besides erecting a winding engine for drawing up coal, and a pumping engine, he projected and laid down a self-acting incline along the declivity of the Willington ballast quay, so arranged that full wagons descending to the vessels drew up the empty ones. But the construction of an efficient and economical locomotive steam engine mainly occupied his attention, and in July, 1814, he completed one which worked successfully on the Killingworth railway, and proved the best yet constructed. It was the first locomotive made with smooth wheels, for he rejected the contrivances which Trevithick, Blenkinsop, and others had thought necessary to secure sufficient adhesion between the wheels and the rails. While engaged in plans for an improved engine, his attention was attracted to the increase in the draught of the furnace obtained by turning the waste steam up the chimney, at first practised solely in the desire to lessen the noise caused by the

escape of the steam. Hence originated the steam blast, the most important improvement in the locomotive up to that time, and it was embodied in Stephenson's next engine, completed in 1815. For some years Stephenson had been experimenting with the fire damp in the mines, and in 1815 he completed a miner's safety lamp, which is still in use in the Killingworth collieries. The invention of a safety lamp by Sir Humphry Davy was nearly simultaneous, and to him the mining proprietors presented a service of plate worth £2,000, at the same time awarding £100 to Stephenson. This led to a protracted discussion as to the priority of the invention, and in 1817 Stephenson's friends presented £1,000 to him. Having brought the locomotive to a considerable degree of perfection, Stephenson next turned his attention to the improvement of railways, his opinion being that both were parts of one mechanism, and that the employment of steam carriages on common roads was impracticable. For the purpose of making railways solid and level, and preventing jerks at the junction of the rails, he took out in 1816 a patent for an improved rail and chair, and recommended the employment of heavier rails and the substitution of wrought for cast iron. In connection with these improvements he added considerably to the lightness and strength of the locomotive, simplified the construction of the working parts, and substituted steel springs for the small cylinders on which the boiler had at first rested. His next important undertaking was the construction of a railway eight miles in length for the owners of the Hetton colliery, which was successfully opened on Nov. 18, 1822, the level parts being traversed by five of Stephenson's locomotives, while stationary engines were employed to overcome the heavy grades. In 1820 an act of parliament was obtained for a railway between Stockton and Darlington, of which Stephenson, who made the preliminary surveys and specifications, was in 1823 appointed engineer. The line was intended to be worked by stationary engines for the steep gradients, with horse power on the level portions; but at Stephenson's urgent request the act was amended so as to permit the use of locomotives on all parts of the road, which was opened Sept. 27, 1825. In 1824, in connection with Edward Pease, he opened an establishment for the manufacture of locomotives at Newcastle-upon-Tyne. In 1825 he was appointed principal engineer of the Liverpool and Manchester line, made the preliminary surveys, and in June 1826, began the construction of the road, which employed him during the next four years. Of the engineering difficulties successfully overcome, the most important was the crossing at Chatmoss, a bog 4½ m. in length, on which the road was made to float. While this road was building, the most eminent engineers persisted in recommending stationary engines in place of locomotives, which they declared unsafe and incapable of attaining high speed; and the clumsy expedient of a series of stationary machines 1½ m. apart, dragging the trains by ropes, would have been adopted but for the energy of Stephenson and a few of his friends. He finally prevailed on the directors to offer a prize of £500 for the most effective locomotive engine for the purposes of the road; and at a trial which took place near Liverpool, Oct. 6, 1829, his engine, the Rocket, constructed by himself and his son Robert, was adjudged to be the best of the four entered, having averaged a speed of 14 m. an hour, and even attained one of 29 m. The distinguishing features of the Rocket, the first high-speed locomotive of the standard modern type, were the multitubular boiler, which was not Stephenson's invention, but was first applied by him to locomotives; the blast pipe; and the direct connection of the steam cylinders to one axle and one pair of wheels. At the opening of the road, Sept. 15, 1830, eight locomotives constructed at the Stephenson works were employed, and Mr. Huskisson, having been accidentally struck down and fatally injured by the Rocket, was conveyed in the Northumbrian, driven by George Stephenson, from Parkside to Eccles, 15 m., at the then unprecedented rate of 36 m. an hour. Stephenson was almost incessantly employed for the next 15 years on new roads, and was called three times to Belgium and once to Spain as a consulting engineer. With his increasing wealth he also engaged extensively and profitably in coal mining and lime works, particularly in the neighborhood of Tapton park, an elegant seat in Derbyshire, where he passed his latter years. He declined the honor of knighthood.—See "Life of George Stephenson," by Samuel Smiles (8vo, London, 1857; 8th ed., including Robert Stephenson, 1864; again enlarged, 1868). **II. Robert,** a railway engineer, son of the preceding, born at Willington, near Newcastle-upon-Tyne, Oct. 16, 1803, died in London, Oct. 12, 1859. After several years' schooling at Newcastle, and a preparatory training in the collieries, he went in 1822 to the university of Edinburgh. He returned home in 1823, and accepted in 1824 an engagement as engineer in South America. In 1827, after a short tour in the United States and Canada, he returned to England, and was employed in the construction of the Liverpool and Manchester railway, and in connection with his father in the improvement of locomotives. After being engaged on several minor railway lines, he was appointed engineer of the London and Birmingham road, which under his direction was completed in 1838; and thenceforth for many years he was almost exclusively occupied with similar undertakings at home and abroad. Among his most remarkable works are the high level bridge over the Tyne at Newcastle, the viaduct over the Tweed valley at Berwick, the Conway bridge, and above all the Britan-

nia tubular bridge across the Menai straits. (See Bridge, vol. iii., p. 275.) He was also employed on railways in Belgium, Sweden, Norway, Italy, France, and other parts of Europe, and visited Egypt several times to superintend the construction of a road between Alexandria and Cairo, on the line of which are two tubular bridges, traversed by trains on the roof instead of the inside, as in the case of the Britannia bridge. He also designed an immense bridge across the Nile at Kaffre Azzayat, and the great Victoria tubular bridge which crosses the St. Lawrence near Montreal, and was formally opened in the summer of 1860. From 1847 till his death he represented the Yorkshire borough of Whitby in parliament. He was a member of several scientific bodies, received a great gold medal of honor from the French industrial exposition of 1855, and from 1855 to 1858 was president of the institute of civil engineers. He published "Description of the Locomotive Steam Engine" (4to, London, 1838); "Report on the Atmospheric Railway System" (4to, 1844); and "The Great Exhibition, its Palace and Contents" (12mo, 1851). Besides Smiles's biography, his life has been written by J. C. Jeaffreson and W. Pole (2 vols., London, 1864).

**STEREOSCOPE** (Gr. στερεός solid, and σκοπέιν, to see), an instrument by aid of which the two eyes view two different pictures of the same object and combine them into one having the appearance of solidity. This illusion is produced by presenting to the right eye a picture which represents the object in perspective as it would appear to that eye alone, and to the left eye the picture of the object as seen by the left eye. If these two pictures exactly represent the object as seen respectively by the right and the left eye, which can readily be accomplished by means of photography, we shall, on looking into the stereoscope, receive the same impression of solidity or relief as is given when both eyes look at the real object. One who has sufficient power of directing the movements of his eyes does not need an instrument to aid him in combining the two pictures on a stereoscopic slide. It is only required that the right eye and the left shall be respectively directed to corresponding points on the right-hand and left-hand pictures. It is said that a stereoscope as just described was conceived by Prof. Elliot of Edinburgh in 1834, but was not constructed by him till 1839, after Sir Charles Wheatstone had in 1838 invented and exhibited his reflecting stereoscope. In Wheatstone's instrument the observer looks with his left eye into a mirror at *a*, fig. 1, and with his right eye into a mirror at *b*. These mirrors are inclined at an angle of about 45°, and hence reflect into the eyes the two pictures placed at *k* and *g*. These pictures therefore appear at the same place behind the two mirrors, and give the observer the impression that he is looking at an object or group of objects having solidity, or the third dimension. In 1849 Sir David Brewster invented a refracting stereoscope. This is more convenient than Wheatstone's, but does not give such well defined effects as the reflecting instrument. In Brewster's ste-

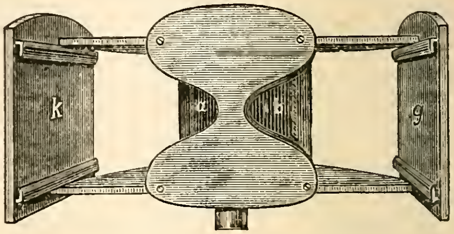



Fig. 1.—Wheatstone's Stereoscope.

reoscope the two pictures are placed side by side, and are separated from each other by a partition, S, fig. 2, so that the right eye can only view the right-hand picture and the left eye the left-hand one. These two pictures are

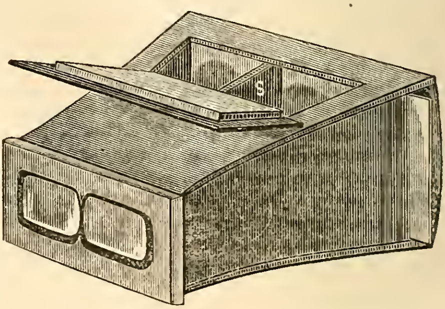



Fig. 2.—Brewster's Stereoscope.

observed through two lenticular prisms, L and R, fig. 3, which not only slightly magnify the pictures, but also cause them to overlap each other; and thus we see in the middle of the instrument one picture which appears in relief.


Fig. 3.—Section of the Eye Pieces.

These effects of solidity can readily be exaggerated by taking the two pictures by means of two photographic cameras, the distance between the centres of whose lenses is greater than that between the centres of the human eyes. The explanation of the illusions of the stereoscope is contained in the explanation of the fact that binocular vision gives us the perception of the third dimension of extension in all objects not over 200 ft. distant from the eyes; for in the stereoscope we have the images formed on the retina of the right eye and of the left similar to the images that would be formed in the eyes if real solid objects were before us, having the sizes and the situations

that they appear to have in the stereoscopic illusion in the instrument; also, the axes of the eyes are inclined to each other in the same manner when looking in the stereoscope as they would be if they regarded the above mentioned group of solid objects. Hence the eye is affected exactly as when it views these real objects, and a stereoscopic perception is the effect. Indeed, a simple rule for all illusions of sight, as Helmholtz concisely states, is "that we always believe that we see such objects as would, under conditions of normal vision, produce the retinal image of which we are actually conscious." The reason that a stereoscopic perception is obtained when we look at a near object is due to the fact that the impressions produced by the two different pictures of this object on the retina, and the muscular adjustment of the ocular axes so that they converge to the same point of the object, are translated, through the experience of touch, as effects belonging to solidity. Some have imagined that they had explained stereoscopic perception by the fact that the axes of the eyes converge to point after point on the object in rapid succession, and thus, as it were, triangulate the positions of these points by a series of visual triangles, which have for their base the distance separating the yellow spots, or *maculæ luteæ*, on the retinas of the eyes (see Eye, fig. 1), and for sides the lines drawn from these spots to the various observed points of the object. But Dove showed that the stereoscopic perception is obtained when we illuminate the pictures in the stereoscope by the flash of a Leyden jar; and Prof. Rood has shown that the duration of this illumination is only four billionths of a second, a duration altogether too short to allow the eyes time to make any motion. Others have maintained that a combination of the impressions produced upon both retinas takes place, and thus the two plane retinal pictures are fused into a stereoscopic perception; but the retinal impressions do not combine, for Dove has shown that when dull black is alone viewed with one eye, while white is regarded with the other, the perception produced is similar to that of the metallic surface of graphite; whereas the real combined sensation of these impressions is a dull gray. From these and many other experiments we learn that "two distinct sensations are transmitted from the two eyes, and reach the consciousness at the same time and without coalescing; that accordingly the combination of these two sensations into the single picture of the external world of which we are conscious in ordinary vision is not produced by any anatomical mechanism of sensation, but by a mental act."—See "The Stereoscope," by Sir David Brewster (London, 1856), and "Recent Progress of the Theory of Vision," by Helmholtz, published in his "Popular Lectures on Scientific Subjects" (New York, 1874).

**STEREOTYPE.** See Printing, vol. xiii., p. 850.

**STERLING.** See Pound Sterling.

**STERLING,** a city of Whitesides co., Illinois, on the N. bank of Rock river, and on the Chicago and Northwestern and the Rockford, Rock Island, and St. Louis railroads, at the terminus of the Rock River branch of the Chicago, Burlington, and Quincy line, 110 m. W. of Chicago and 28 m. E. of the Mississippi river; pop. in 1860, 2,428; in 1870, 3,998; in 1875, 5,312. It is lighted with gas, and is supplied with water by the Holly system of works and by an artesian well 1,650 ft. deep, discharging 700 barrels an hour. It is chiefly devoted to manufacturing. The river at this point is spanned by a dam of solid masonry, 1,100 ft. long and 7 ft. high, which with the 9 ft. natural fall of the rapids above affords an immense water power. The value of the manufactures of Sterling and Rock Falls (opposite) in 1874 was about $4,250,000, and the number of hands employed upward of 1,000. The articles are principally of wood, including agricultural implements, school furniture, feed mills, pumps, burial cases, carriages and wagons, building materials, butter tubs, washing machines, barrels, hedge trimmers, tables, mittens, machinery, mineral paint, paper, &c. There are five flour mills, a distillery (the largest in the United States), two tanneries, and a pork-packing establishment. Sterling has a national bank, three public school houses, two reading rooms, a public library, two weekly newspapers, and 12 churches. It was laid out in 1836, and incorporated as a city in 1857.

**STERLING, John,** a British author, born at Kames castle, isle of Bute, July 20, 1806, died at Ventnor, isle of Wight, Sept. 18, 1844. He was educated at Glasgow and Cambridge universities, in 1827 went to London, and for a few months in 1828 edited with F. D. Maurice the "Athenæum." In 1830–'31 he passed 15 months on St. Vincent island, West Indies, for his health, the state of which required intervals of residence in the south of France, Madeira, and Italy through the rest of his life. In 1834 he took deacon's orders and became curate to his former college tutor J. C. Hare, rector of Hurstmonceaux, Sussex; but in February, 1835, he went to London to devote himself to literature. In August, 1838, he founded the Anonymous club, afterward called the Sterling club. Among the members were Carlyle, Tennyson, Moncton Milnes, John Stuart Mill, J. C. Hare, C. L. Eastlake, Sir Edmund Head, and G. C. Lewis. Sterling published "Arthur Coningsby," a novel (London, 1833); "Minor Poems" (1839); "The Election," a poem (1841); and "Strafford," a drama (1843). After his death appeared "Essays and Tales," collected from various reviews, with a memoir by J. C. Hare (2 vols. 8vo, 1848); "Life of John Sterling," by Thomas Carlyle (1851); "Twelve Letters by John Sterling," edited by W. Coningham (1851); and "The Onyx Ring," from "Blackwood," with a biographical preface by Charles Hale (Boston, 1856).

**STERN, Daniel.** See AGOULT, MARIE CATHERINE SOPHIE DE FLAVIGNY.

**STERNBERG,** a town of Moravia, 10 m. N. of Olmütz; pop. in 1870, 13,479. It has an old palace and a military school, and is the great centre of the Moravian manufacture of cotton and linen goods.

**STERNE, Laurence,** an English author, born in Clonmel, Ireland, Nov. 24, 1713, died in London, March 18, 1768. His parents were English, and his father, Roger Sterne, was a lieutenant in Handaside's regiment, the movements of which, "from barrack to transport, from Ireland to England," young Laurence followed until his 10th year, when he was put to school at Halifax in England. He graduated at Cambridge in 1736, took orders, and was presented to the living of Sutton in Yorkshire. In 1741 he married, and about the same time obtained the living of Stillington, adjoining Sutton, while his uncle procured him a prebend in York cathedral. For nearly 20 years his only acknowledged publications were two sermons, although he wrote political paragraphs for the newspapers, and is said to have conducted for some time a periodical electioneering paper in the whig interest. In 1759 he published at York, under the pseudonyme of "Mr. Yorick," the first two volumes of "Tristram Shandy," which were reprinted in London early in 1760. The 3d and 4th volumes appeared in 1761, the 5th and 6th in 1762, the 7th and 8th in 1765, and the 9th in 1767. Long before the completion of the work, the charm and the novelty of the style, the whimsical digressions, the exquisite touches of pathos and humor, and its many admirably conceived characters, had taken an extraordinary hold upon the public, and Sterne ranked with Fielding and Richardson and Smollett as a great writer of prose fiction. He was lionized in London, where people were invited a fortnight in advance to dine with him; and Boswell has recorded Johnson's remark that "the man, Sterne, had engagements for three months." The erudition which so greatly astonished the not very learned readers who welcomed the appearance of "Tristram Shandy" will, however, scarcely stand the test of modern criticism, and it has been shown by Dr. Ferriar, in his "Illustrations of Sterne" (1798), that the quaint imagery and the quainter conceits scattered through the book were largely borrowed from Rabelais, Burton, and other authors. But after making liberal allowances for plagiarisms, his Uncle Toby, Corporal Trim, Mr. Shandy, Dr. Slop, and Widow Wadman must be considered among the most original personages in fiction. In 1760 and 1766, during the publication of "Tristram Shandy," appeared four volumes of sermons, also by "Mr. Yorick." In 1760 Sterne received an additional living at Coxwold in Yorkshire, and took a house in York for his wife and daughter, but passed most of his own time in London or on the continent. In 1762 he visited France, and in 1764 went to Italy for his health. Returning to York in 1767 he wrote the first and only part of "The Sentimental Journey," and took it to London for publication. Soon after its appearance he died without a friend near him, and was privately buried at Edgeware. In 1775 his daughter Lydia published three volumes of his "Letters to his Friends," accompanied by a short autobiographical memoir; and in the same year appeared "Letters to Eliza," consisting of ten letters addressed by Sterne in March and April, 1767, to "Mrs. Elizabeth Draper, wife of Daniel Draper, Esq., counsellor at Bombay, and at present chief of the factory at Surat," and another collection of letters in one volume. "Seven Letters by Sterne and his Friends," edited by W. Durrant Cooper, were privately printed in 1844. The most complete edition of Sterne's works was edited by James P. Browne, M. D., and comprises in an appendix 13 letters hitherto unpublished (4 vols. 8vo, London, 1873).—Of the personal character of Sterne, as seen in his life and letters, no favorable impression can be formed. The latter show him to have been indifferent to the duties of his profession, lax in principle, a bad husband, a faithless lover, offering his affections to two or three married women at once, the dupe of every coarse flatterer, and false to his professions of virtue or sensibility.

**STERNHOLD, Thomas,** an English writer, born in Hampshire about 1500, died in August, 1549. He was groom of the robes to Henry VIII. and Edward VI., and was noted at court for his poetical talents and piety. He undertook a translation into metre of the Psalms of David, but completed only 37, printed in 1549, after his death, with seven by John Hopkins, under the title of "All such Psalms of David as Thomas Sternholde, late Grome of the Kinges Majestyes Robes, did in his lyfe-tyme drawe into Englyshe Metre." The version was completed and published in 1562 as "The Whole Book of Psalms, collected into English Metre by T. Sternhold, J. Hopkins, and others, conferred with the Ebreu; with apt Notes to sing them withal;" under which title it was annexed to the "Book of Common Prayer," and was used till superseded by Tate and Brady's collection (1696). Sternhold was also the author of "Certain Chapters of the Proverbs of Solomon, drawen into Metre" (1549).

**STESICHORUS,** a Greek lyric poet, born in Himera, Sicily, in 632 B. C., died about 555. He is said to have been educated at Catana, and to have been on friendly terms with Phalaris of Agrigentum. It is said that his real name was Tisias, and that he received the name of Stesichorus, "chorus leader," for his efforts in choral poetry, for which he invented the divisions of strophe, antistrophe, and epode. He wrote in the Doric dialect. His poems were chiefly on heroic subjects, although he wrote

many on themes more purely lyrical. He was the first of the Greeks who composed erotic poems. The fragments of his writings have been collected by Kleine (*Stesichori Himerensis Fragmenta*, Berlin, 1828); by Schneidewin in his *Delectus Poesis Græcorum* (Göttingen, 1839); and by Bergk in *Poetæ Lyrici Græci* (3d ed., Leipsic, 1867).

**STETHOSCOPE.** See AUSCULTATION.

**STETTIN,** a town of Prussia, capital of the province of Pomerania, on the left bank of the Oder, 76 m. N. E. of Berlin; pop. in 1871, 76,149. The river is crossed by two bridges, and the town and suburbs are defended by walls, a citadel, and several forts and outworks. Stettin has several fine squares, with monuments of Frederick the Great and Frederick William III., is generally well built, and possesses a school of navigation, with an observatory. The ancient castle of Stettin, which was the residence of the dukes of Pomerania, contains a collection of northern antiquities. Chemical products, woollen, linen, cotton, sugar, anchors, &c., are manufactured. The imports amounted in 1873 to 87,631,985 thalers, and the exports to 30,394,333 thalers. The registered shipping included 30 sea-going steamers and 178 other vessels. Vessels drawing over 15 ft. cannot ascend the Oder, and discharge at Swinemünde on the Baltic, 35 m. distant. The town was a considerable place as early as the 9th century, and was a member of the Hanseatic league. It belonged to Sweden from 1648 to 1720.

**STEUART, Sir James Denham,** a Scottish political economist, born in Edinburgh in October, 1713, died Nov. 26, 1780. He was educated at the university of Edinburgh, and in 1734 was admitted to the Scottish bar. Although of a whig family, he became imbued with Jacobite doctrines. Having declared for the young pretender in 1745, he was sent by him on a mission to the court of France, and the consequence was a compulsory absence from Great Britain for 17 years. In 1763 he was permitted to return to Scotland, and in 1771 he obtained a free pardon. While abroad he published works in French and German on chronology and money, and in 1767 produced his "Inquiry into the Principles of Political Economy" (2 vols. 4to, London). He also wrote "The Principles of Money applied to the Present State of the Coin of Bengal" (1772), "A Plan for introducing an Uniformity of Weights and Measures" (1790), &c. A complete edition of his works was edited by his son, Gen. Sir James Denham Steuart (6 vols., 1805). (See POLITICAL ECONOMY, vol. xiii., p. 668.)

**STEUBEN. I.** A S. W. county of New York, bordering on Pennsylvania, drained by Chemung, Canisteo, Tioga, and Conhocton rivers; area, 1,425 sq. m.; pop. in 1870, 67,717; in 1875, 73,923. The surface is broken and the soil generally fertile. Iron ore and good building stone are found. There are two or three small lakes, and Keuka (formerly Crooked) lake is partly within the county. It is traversed by the Erie railway and branches, and by the Corning, Cowanesque, and Antrim railroad. Considerable lumber is exported. The chief productions in 1870 were 540,557 bushels of wheat, 72,792 of rye, 344,299 of Indian corn, 1,538,117 of oats, 207,024 of barley, 286,102 of buckwheat, 543,687 of potatoes, 169,294 tons of hay, 150,540 lbs. of tobacco, 700,704 of wool, 62,118 of hops, 112,228 of maple sugar, 87,013 of honey, 2,834,636 of butter, and 233,438 of cheese (not including factory cheese). There were 15,642 horses, 30,329 milch cows, 2,993 working oxen, 22,717 other cattle, 145,645 sheep, and 15,430 swine; 5 manufactories of agricultural implements, 48 of carriages and wagons, 7 of cheese, 16 of cooperage, 15 of furniture, 1 of glass ware, 8 of iron castings, 19 of tanned and 9 of curried leather, 4 of machinery, 22 of saddlery and harness, 2 of wine, 2 woollen mills, 3 distilleries, 5 breweries, 89 saw mills, and 18 flour mills. Capitals, Bath and Corning. **II.** A N. E. county of Indiana, bordering on Ohio and Michigan, and intersected by the St. Joseph's and Pigeon rivers; area, 340 sq. m.; pop. in 1870, 12,854. The surface is prairie and woodland, and the soil is fertile. The chief productions in 1870 were 232,816 bushels of wheat, 352,200 of Indian corn, 97,719 of oats, 90,020 of potatoes, 16,861 tons of hay, 117,337 lbs. of wool, 289,472 of butter, and 3,313 of sorghum molasses. There were 4,122 horses, 3,823 milch cows, 5,838 other cattle, 32,387 sheep, and 11,332 swine. The Fort Wayne, Jackson, and Saginaw railroad passes through the capital, Angola.

**STEUBEN, Frederick William Augustus,** baron, an American soldier, born in Magdeburg, Prussia, Nov. 15, 1730, died near Utica, N. Y., Nov. 28, 1794. He was educated at the Jesuit colleges of Neisse and Breslau, and became a cadet in an infantry regiment in 1747, an ensign in 1749, and a lieutenant in 1753. In 1757 he distinguished himself at the battles of Prague and Rossbach, in 1758 was appointed an adjutant general, and was in the battles of Kay and Kunersdorf in 1759, in the latter of which he was wounded. In 1762 he was made adjutant general in the king's staff. He was a member of Frederick's select academy of young officers who were under his special instruction; and after the siege of Schweidnitz, in which he participated, the king presented him with a valuable lay benefice. At the close of the seven years' war he accompanied to several courts of Europe the prince of Hohenzollern-Hechingen, who in 1764 made him grand marshal and general of his guard. In 1777, while on a visit to France, he was induced by the count St. Germain to go to America. He arrived at Portsmouth, N. H., Dec. 1, and immediately wrote to congress and to Gen. Washington, tendering his service as a volunteer. Shortly afterward he went to York, Pa., where congress was in session, was di-

rected to join the army under Washington, and during the winter arrived at Valley Forge. On May 5, 1778, he was appointed inspector general with the rank of major general, and in June he was at the battle of Monmouth. He prepared a manual for the army, which was approved by congress in 1779, and introduced the most thorough discipline. In 1780 he was a member of the court martial on the trial of Major André. In the same year he was placed in command of the troops in Virginia, and in January following was active in harassing the British forces under Benedict Arnold. In the summer he was attached to Gen. Lafayette's division, and took part in the siege of Yorktown. In 1790 congress voted him a life annuity of $2,500. Several of the states passed resolutions acknowledging his services, and voted him tracts of land. New York presented him with 16,000 acres near Utica, forming a township called from him Steuben, where he passed the remainder of his life, giving portions of the land to his aids, and leasing the remainder. His life has been written by Francis Bowen in Sparks's "American Biography," and by Friedrich Kapp (New York, 1860).

**STEUBENVILLE,** a city and the capital of Jefferson co., Ohio, on the Ohio river, here crossed by a railroad bridge, 22 m. N. by E. of Wheeling, W. Va., 35 m. W. of Pittsburgh, Pa., and 125 m. E. by N. of Columbus; pop. in 1860, 6,154; in 1870, 8,107; in 1875, locally estimated at 15,000. It stands on an elevation on the right bank of the river, is well laid out and substantially built, is surrounded by a rich farming and stock-growing country, and is the centre of an important trade. Abundance of excellent coal is found in the neighborhood, and there are eight shafts within the city limits. The court house is the finest in eastern Ohio. The city has water works, gas works, and two steam fire engines. The Pittsburgh, Cincinnati, and St. Louis railroad, and the river division of the Cleveland and Pittsburgh railroad, intersect here. The river trade is extensive. The chief manufactories are two founderies and machine shops, two rolling mills, a nail mill, two engine and boiler works, three blast furnaces, a flouring mill, two woollen mills, a paper mill, three breweries, and two glass works. There are two national banks, two private banks, two savings institutions, nine public schools, including a high school, a female seminary, a Roman Catholic school, two daily and two weekly newspapers, and 18 churches (Christian, Congregational, Episcopal, Lutheran, Methodist, Presbyterian, and Roman Catholic).—A blockhouse was erected on the site of Steubenville in 1786, and in 1787 a fort was built and named in honor of Baron Steuben; but the place was not permanently settled till 1797. It was incorporated as a city in 1851, and in 1871 its limits were extended.

**STEVENS.** I. A W. county of Minnesota, intersected by the Pomme de Terre river, a tributary of the Minnesota; area, 576 sq. m.; pop. in 1870, 174. The surface is rolling and is studded with numerous lakes. The soil is productive. The St. Paul and Pacific railroad traverses it. **II.** An unorganized S. W. county of Kansas, bordering on Indian territory; area, 720 sq. m. It is intersected by the Cimarron river. The surface is undulating. **III.** A N. W. county of Dakota, bounded S. W. by the Missouri river, recently formed and not included in the census of 1870; area, about 3,100 sq. m. It is mostly occupied by the Plateau du Coteau du Missouri. The N. E. corner is intersected by Mouse river. **IV.** The N. E. county of Washington territory, bordering on British Columbia and Idaho, bounded S. in part by the Snake river, W. in part by the Cascade mountains, and intersected by the Columbia; area, 28,000 sq. m.; pop. in 1870, 734. Lake Chelan is in the W. part, and the county is watered by Clarke's fork, the Okinakane, Palouse, Spokane, and other streams. There are broad plains and rugged mountains, with some barren places, but the proportion of valuable land is large, and much of it is very fertile. The climate is mild. There are gold mines on the bars of the Columbia and lateral streams. The chief productions in 1870 were 8,791 bushels of wheat, 12,504 of oats, 3,825 of potatoes, and 791 tons of hay. There were 415 horses, 1,100 cattle, and 485 swine. Capital, Colville.

**STEVENS, Abel,** an American clergyman, born in Philadelphia, Jan. 19, 1815. He studied at Wesleyan university, Middletown, Conn., and in 1834 was settled as pastor of a Methodist Episcopal church in Boston. In 1837 he travelled in Europe, and on his return was stationed in Providence, R. I. In 1840 he took editorial charge of "Zion's Herald" in Boston, and in 1852 of the "National Magazine," New York; in 1855 revisited Europe, and on returning in 1856 was elected editor of the "Christian Advocate and Journal," New York. He afterward became joint editor of "The Methodist," from which he retired in 1874. Dr. Stevens has published "Memorials of the Introduction of Methodism into New England" (1848); "Memorials of the Progress of Methodism in the Eastern States" (1852); "Church Polity;" "The Preaching required by the Times" (1855); "Sketches and Incidents, a Budget from the Saddle Bags of an Itinerant;" "The Great Reform;" "History of the Religious Movement of the Eighteenth Century called Methodism" (3 vols., 1858–'61), which has been several times edited and reprinted in England; "Life and Times of Nathan Bangs, D. D." (1863); "History of the Methodist Episcopal Church in the United States of America" (4 vols., 1864–'7); "The Centenary of American Methodism" (1866); "The Women of Methodism" (1866); and "Compendium of the History of Methodism" (1868).

**STEVENS, Alexander Hodgdon,** an American surgeon, born in New York in 1789, died there, March 30, 1869. He graduated in medicine in 1815 at the university of Pennsylvania, and

became surgical dresser and afterward house surgeon in the New York hospital. In 1817 he was appointed attending surgeon there, and in 1839 consulting surgeon. He was professor of the principles and practice of surgery in the college of physicians and surgeons, New York, from 1826 to 1837, and of clinical surgery from 1837 to 1839. He was also president of the college from 1843 to 1855. In 1848 he was chosen president of the state medical society.

**STEVENS, Alfred** (two). See p. 898.

**STEVENS, George Alexander,** an English author, born in London in the early part of the 18th century, died at Baldock, Hertfordshire, Sept. 6, 1784. He was at first a strolling actor, and acquired reputation as a writer of burlesques and of comic songs. In 1760 he published a novel, "The History of Tom Fool," and a few years later produced an entertainment entitled "A Lecture on Heads." He also published a volume of "Songs, Comic and Satirical" (1772); and after his death appeared "The Adventures of a Speculist, compiled from the Papers of G. A. Stevens, with his Life, a Preface, and Notes" (1788).

**STEVENS. I. John,** an American inventor, born in New York in 1749, died in Hoboken, N. J., in 1838. He early engaged in solving the problem of steam navigation, and in a memorial to the legislature of New York in 1789 stated that he had perfected his plans. In 1804 he launched a propeller, using the screw, and in 1805 he employed twin screws. He completed the steamboat Phœnix in 1807, and being prevented by Fulton's monopoly from navigating the Hudson, he sent the vessel to sea and up the Delaware. Her engines were high-pressure condensing, and the boilers of the kind now called sectional. Neither these nor either single or twin screws were generally employed by engineers until many years afterward. In 1812 he designed a circular iron-clad or revolving steam battery with armor plating, substantially the same as those recently designed by the late John Elder, and like those now constructing for the Russian navy; and in the same year he published a pamphlet on railroads, indicating the mode of applying steam, calculating their cost, and predicting the speed of trains. He planned the Camden and Amboy railroad. **II. Robert Livingston,** son of the preceding, born in Hoboken, N. J., in 1788, died there, April 20, 1856. He had charge of his father's steamboat the Phœnix in its passage to the Delaware, and in 1808 introduced concave water lines in her hull, the first application of the wave line to ship building; and he was afterward largely engaged in building steamboats. In 1813-'14 he invented and sold to the government percussion elongated shells for smooth-bore guns; in 1818 he burned anthracite coal in a cupola furnace, and soon after used it in his steamers. In 1822 he substituted the skeleton wrought-iron working beam for the heavy cast-iron one before in use; and during the next 27 years he made numerous other improvements in steam machinery and navigation. In 1836 he introduced the T rail on the Camden and Amboy railroad, of which he was president for many years. In 1842 he was commissioned by the United States government to build an iron-plated war steamer or battery, to be shell-proof and driven by screws. (See IRON-CLAD SHIPS.) In consequence of a change of his plan, it was unfinished at his death. **III. Edwin Augustus,** brother of the preceding, born in Hoboken in 1795, died in Paris, France, Aug. 7, 1868. With his brothers he established lines of steam passenger and tow boats on the Hudson and other rivers. He also made several inventions and improvements in machinery and naval architecture. At the opening of the civil war he endeavored, in conjunction with his brother James C., to induce the government to take and put in service the iron-clad battery begun by Robert L. Stevens, offering to complete the ship at their own expense, payment only to be made in case of her success. For the purpose of showing the feasibility of their plans, they fitted out the small iron-clad Naugatuck, and sent her into action; she took part in the engagement on the James river, and rendered valuable assistance. The government declined the offer, and Edwin A. Stevens left at his death $1,000,000 for the completion of his brother's plans. The amount proved insufficient, however, and the vessel was sold to the United States navy in November, 1874, by the state of New Jersey, to which he had bequeathed it. Congress having failed to make the appropriation for the purchase, the vessel still remains (1876) in dock at Hoboken. Mr. Stevens possessed an immense fortune. He endowed the Stevens high school at Hoboken, and at his death left nearly $1,000,000 for the purpose of founding the Stevens institute of technology. (See HOBOKEN.)

**STEVENS. I. Joseph,** a Belgian painter, born in Brussels about 1819. He is the son of a French officer, is self-taught, and resides alternately at Paris and Brussels, and is distinguished for his pictures of animals, especially dogs, and also for his genre paintings. **II. Alfred,** a Belgian painter, brother of the preceding, born in Brussels in 1828. He completed his studies under Roqueplan in Paris, and has made himself known by his genre pictures, such as "The Visit," "The Pink Lady," and "The Love of Gold."

**STEVENS, Thaddeus,** an American statesman, born at Peacham, Caledonia co., Vt., April 4, 1793, died in Washington, D. C., Aug. 11, 1868. His parents were poor, and he was lame and sickly from childhood; but he qualified himself by hard study to enter college, and graduated with honor at Dartmouth in 1814. He went immediately to York, Pa., where he taught school and studied law, and soon obtained a large practice. He kept aloof from politics till the election of Jackson in 1828, against whom he took part with great ardor, and became an

active member of the whig party. In 1833 and for several succeeding years he was a member of the Pennsylvania legislature, and he became distinguished by his opposition to slavery. He was appointed a canal commissioner in 1838, and rendered important services to the state in the promotion of her system of internal improvements. In 1842 he removed to Lancaster, and for six years devoted himself to his profession. He was elected representative in congress in 1848 and reëlected in 1850. He strongly opposed the fugitive slave law and the Kansas-Nebraska bill. He was again elected to congress in 1858, and held his seat till his death. In his latter years in congress he was a recognized chief of the republican party, and took the lead in all measures for emancipating and arming the negroes and for giving them citizenship. He also advocated acts of confiscation and other severe measures against the confederates; and he was chairman of the managers for the impeachment of President Johnson.

**STEVINUS,** or **Stevin, Simon,** a Flemish mathematician, born in Bruges about 1550, died at the Hague about 1630. The particulars of his life are unknown. In 1586 he published in Dutch a work on "Statics and Hydrostatics" and "A new System of Fortification;" in 1589 a tract on the motion of the heavens; and in 1599 a treatise on navigation (translated into Latin by Grotius, Leyden, 1624). In 1605 Willebrord Snell translated into Latin most of the works of Stevinus, but died before completing the translation. In 1634 Albert Girard published at Leyden all his works in French, including a collection of geometrical problems.—See *Simon Stevin*, by Quetelet (Brussels, 1845).

**STEWARD, Lord High,** in England, the highest officer under the crown, who was formerly known by the Latin title of *magnus seneschallus.* Under the Plantagenets the office was hereditary, and was held by the house of Leicester, until forfeited by Simon de Montfort. Since the reign of Henry IV. it has been abolished as a permanent dignity, and is conferred for some special occasion, as a trial before the house of peers or a coronation. The lord high steward presides at the former, and at the close of the proceedings breaks his wand and dissolves the court.—The office of steward, or stewart, also existed from early times in Scotland, and gave name to the royal family of Stuart, in which it was hereditary from the time of David I. (1124–'53) till the accession to the throne of Robert (II.) Stuart, grandson of King Robert Bruce, in 1371.

**STEWART. I.** A S. W. county of Georgia, bounded W. by the Chattahoochee river, which separates it from Alabama, and drained by several of its tributaries; area, about 500 sq. m.; pop. in 1870, 14,204, of whom 9,100 were colored. The soil is fertile. The chief productions in 1870 were 271,288 bushels of Indian corn, 26,103 of sweet potatoes, and 13,643 bales of cotton. There were 703 horses, 1,933 mules and asses, 1,759 milch cows, 3,963 other cattle, 1,150 sheep, and 8,270 swine. Capital, Lumpkin. **II.** A N. W. county of Tennessee, bordering on Kentucky, intersected by the Cumberland river and bounded W. by the Tennessee; area, about 425 sq. m.; pop. in 1870, 12,019, of whom 2,700 were colored. The surface is undulating and the soil very fertile. Valuable iron ore abounds. The Louisville, Nashville, and Great Southern railroad passes through it. The chief productions in 1870 were 31,380 bushels of wheat, 428,311 of Indian corn, 26,623 of oats, 17,635 of Irish and 18,746 of sweet potatoes, 1,809 bales of cotton, 1,191,620 lbs. of tobacco, 16,135 of wool, and 10,335 gallons of sorghum molasses. There were 1,579 horses, 2,158 milch cows, 3,575 other cattle, 8,939 sheep, and 15,652 swine; 3 manufactories of pig iron, and 1 of blooms. Capital, Dover.

**STEWART, Alexander Turney,** an American merchant, born near Belfast, Ireland, Oct. 27, 1802, died in New York, April 10, 1876. He studied at Trinity college, Dublin, but did not take a degree, emigrated to New York in 1823, and engaged in teaching. In 1825 he began, at No. 283 Broadway, a dry-goods business which gradually expanded into one of the largest mercantile concerns in the world. He sent a ship load of provisions to Ireland during the famine of 1846, and made similar gifts to the sufferers by the Franco-German war and by the Chicago fire in 1871. In 1867 he was chairman of the honorary commission sent by the United States government to the Paris exposition. In March, 1869, President Grant appointed him secretary of the treasury, but his confirmation was prevented by the law which excludes from that office all who are interested in the importation of merchandise. Mr. Stewart left nearly completed a building on 4th avenue and 32d street, New York, costing more than $1,000,000, which was understood to be intended as a home for working girls, but which was finally made a general hotel; and he was also building at Hempstead Plains, Long Island, on a tract of 10,000 acres, a town known as Garden City.

**STEWART, Balfour,** a British physicist, born in Edinburgh, Nov. 1, 1828. He studied in the universities of St. Andrews and Edinburgh, and in 1852 engaged in business in Melbourne, Australia; but in 1854 he retired to Richmond, near Melbourne, and devoted himself to science. In 1855 he returned, and was assistant for six months to John Welch, superintendent of the Kew observatory, and afterward for three years to Prof. Forbes in Edinburgh, lecturing on mechanics and assisting in experiments. In 1859 he was appointed superintendent of the Kew observatory, and in 1861 examiner in the universities of London and Edinburgh. In 1868 he received the Rumford medal from the royal society. In 1870 he was appointed professor of natural philosophy in Owens college, Manchester, still retaining the directorship of the Kew observatory. Besides several papers in the "Transactions" of the royal society, he has published

"Elementary Lessons in Physics" (London, 1870); "Elementary Treatise on Heat" (1871); "Physics Primer" (1872); and "The Conservation of Energy" (1873).

**STEWART, Charles**, an American naval officer, born in Philadelphia, July 28, 1778, died in Bordentown, N. J., Nov. 7, 1869. He entered the merchant service at the age of 13 as cabin boy, and rose to the command of an Indiaman. In March, 1798, he entered the navy as lieutenant in the frigate United States, employed in the West Indies against French privateers. In July, 1800, he was appointed to the command of the schooner Experiment, of 12 guns. On Sept. 1 he captured, after an action of 10 minutes, the French schooner Deux Amis, of 8 guns; and soon after, near the island of Barbuda, the French schooner Diana, of 14 guns. He also recaptured several American vessels which had been taken by French privateers. As commander of the brig Siren he participated in the naval operations of 1804 against Tripoli, and aided in the destruction of the frigate Philadelphia. He became captain in 1806. In the summer of 1813 he took command of the Constitution, and in December sailed from Boston upon a cruise to the coasts of Guiana and the Windward islands, which resulted in the capture of the British schooner of war Pictou, of 14 guns, a letter of marque under her convoy, and several merchant vessels. About the middle of December, 1814, he sailed in the same ship upon a second cruise, and on Feb. 20, 1815, captured, after an action of 40 minutes fought at night, H. B. M. ship Cyane, mounting 34 guns, with 185 men, and the sloop of war Levant, of 21 guns and 156 men. The Constitution mounted 52 guns with 470 men. Her loss was 3 killed and 12 wounded, while the total loss of the British ships has been stated at 41. The Levant was recaptured by a British squadron. From 1816 to 1820 Com. Stewart commanded a squadron in the Mediterranean, and from 1821 to 1823 in the Pacific. He afterward served on the board of navy commissioners, and as commander of the home squadron and the naval station at Philadelphia. In 1857 he was placed on the retired list, but resumed service in 1859 as commander of the Philadelphia navy yard, under a new commission as senior flag officer; and on July 16, 1862, he was made a rear admiral on the retired list.

**STEWART, Dugald**, a Scottish metaphysician, born in Edinburgh, Nov. 22, 1753, died there, June 11, 1828. His father was the Rev. Dr. Matthew Stewart (1717–'85), professor of mathematics in the university of Edinburgh, and author of several mathematical works. He was educated at the high school and university of his native city, heard the lectures of Reid at Glasgow during one term (1771–'2), was recalled to Edinburgh to act as his father's substitute in the charge of the mathematical classes, and was formally elected conjoint professor in 1775. For several years he was prominent in the weekly debates of the speculative society, before which he also read essays on philosophical subjects. He was elected professor of moral philosophy in 1785, and lectured in this department during the next 24 years. His aim was always moral and practical more than speculative, to portray ideal perfection and advance the harmonious culture of all the faculties, intellectual, moral, and sensitive, rather than to teach definite solutions of intellectual problems; and his lectures therefore proceeded from psychology to theories of character and manners, life and literature, taste and the arts, politics and natural theology. The prominence which he assigned to the last subject, as the highest branch of metaphysics, was designed, as he explained, to resist the prevalent skeptical tendencies of the era of the French revolution. From the beginning he gave lectures on the theory of government as a part of the course on moral philosophy, and in 1800 he first delivered a special course on the new science of political economy. He published the first volume of "Elements of the Philosophy of the Human Mind" in 1792. In the following year he published his "Outlines of Moral Philosophy," and read before the royal society an account of the life and writings of Adam Smith, which was printed in the "Transactions," and was followed by his biographies of Dr. Robertson (1796) and Dr. Reid (1802). Nothing else appeared from his pen till 1810, though in this interval he prepared the matter of all his other writings, with a single exception. In 1806 the sinecure office of gazette writer of Scotland was created for him. He accompanied in that year Lord Lauderdale on his mission to Paris. In 1810 he retired, on account of failing health, from active duty as a professor, and published his "Philosophical Essays." He had in the mean time removed to Kinneil house, on the shore of the frith of Forth, 20 m. from Edinburgh, where he passed the remainder of his life. His later publications are: "Elements of the Philosophy of the Human Mind," vol. ii. (1814), and vol. iii. (1827); a preliminary dissertation to the supplement of the "Encyclopædia Britannica," entitled "A General View of the Progress of Metaphysical, Ethical, and Political Science since the Revival of Letters" (part i., 1815; part ii., 1821); and "The Philosophy of the Active and Moral Powers" (1828), which was completed only a few weeks before his death. In 1822 paralysis deprived him of the power of speech and of the use of his right hand, but by the aid of his daughter as an amanuensis he continued his studies until disabled by a fresh paralytic shock, which soon terminated fatally.—His collected works were edited by Sir William Hamilton (10 vols. 8vo, Edinburgh, 1854–'8; supplement, 1860). His lectures on political economy were first published in this edition. The 10th volume contains a memoir by John Veitch, with selections from his correspondence.

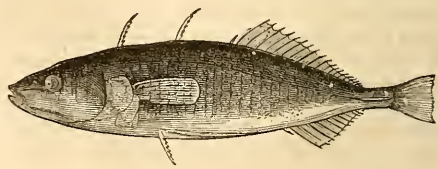
**STEWART, John,** an English traveller, born in London about 1740, died there in 1822. He went to Madras in 1763, in the civil service of the East India company, but at the end of two years resigned his office and began a series of pedestrian tours through Hindostan, Persia, Nubia, and Abyssinia, in the course of which he was at different times in the service of the nawaub of Arcot and of Hyder Ali. He next walked to Europe by the way of the Arabian desert; and having perambulated every part of Great Britain, he crossed the Atlantic and visited on foot many parts of the United States. He was commonly called "walking Stewart." His writings were printed in three volumes in 1810, mainly for private distribution. An account of his life and adventures was published after his death (London, 1822).

**STEWART, Robert Henry,** marquis of Londonderry. See CASTLEREAGH.

**STEWART ISLAND.** See NEW ZEALAND.

**STEYER, Steier,** or **Steyr,** a town of Upper Austria, between the Steyer and the Enns, at their junction, 19 m. S. E. of Linz; pop. in 1870, 13,392. It is united with its suburbs Ennsdorf and Steyerdorf by two bridges. There are extensive manufactures of hardware and cutlery in the town and surrounding villages. It was once the capital of a county, and till 1192 belonged to Styria, which from it derived its name (Ger. *Steyermark*).

**STICKLEBACK,** the popular name of the acanthopterous fishes of the mailed-cheeked family or *sclerogenidæ*, and genus *gasterosteus* (Linn.). They are also called banstickles, and are the *épinoches* of the French. Most of the species are found in fresh water, and are from 2 to 3 in. long; the sides are more or less protected by bony plates, the other parts being without scales; very small and crowded teeth on the jaws, none on the palate; branchiostegal rays three; tail keeled on both sides; ventrals abdominal, reduced to a strong spine, used as a weapon, and one or two soft rays; free spines, from 3 to 15 in front of the dorsal, which is supported by soft rays; bones of the pelvis large, forming an abdominal sternum. They feed on aquatic insects and worms, and the fry of fish; their pugnacity exceeds that of any other fish, and their voracity and fearlessness make it easy to capture them by the simplest means; they are very active, and sometimes spring entirely out of water. They breed in summer, in nests built by the males, which at this season have the throat carmine red and the eyes brilliant bluish green, the other parts above being ashy green and the abdomen silvery and translucent. The nest is made of delicate vegetable fibres, matted into an irregular circular mass cemented by mucus from the body, an inch or more in diameter, attached to water plants, with one or two openings near the centre; when the nest is prepared the female is enticed or driven in, and there deposits her eggs, which are fecundated by the male; the latter remains constantly on guard, swimming in the neighborhood, driving away intruders with great ferocity, frequently putting in his head to see if all is right, and fanning the water with the pectorals and caudal to secure free circulation and ventilation for the eggs; he is frequently seen shaking up the eggs, and carrying away impurities in the mouth. The young are hatched in two or three weeks, and grow very slowly; any of the small fry getting outside of the nest are instantly seized in the mouth of the parent and put back. There are about 40 young to a nest.—The common European species (*G. aculeatus*, Linn.; since separated into three by Cuvier) has three spines in front of the dorsal, and is found in almost every pool and rivulet in Great Britain. The *G. spinachia* (Linn.) has 14 or 15 free spinous rays on the back, and has an elongated head and body; it is a marine species, found in the northern seas of Europe. The best known of the many species in the United States are the two-spined stickleback (*G. biaculeatus*, Mitch.), which is found from Labrador to New York, 2 in. long, olive-green above, yellowish



Two-spined Stickleback (Gasterosteus biaculeatus).

green on sides, with two distant spines on the back and a third near the dorsal; and the four-spined stickleback (*G. quadracus*, Mitch.), of the Massachusetts and New York coasts. Other species have eight to ten spines, and the males in all assume the red tint in the breeding season, both in salt and fresh water.

**STICKNEY, Sarah.** See ELLIS, WILLIAM.

**STIEGLITZ. I. Christian Ludwig,** a German author, born in Leipsic, Dec. 12, 1756, died there, July 17, 1836. He was an architect, held important local offices, and published poetical and other works, but is chiefly known by his *Encyklopädie der Baukunst der Alten* (5 vols., Leipsic, 1792–'8) and *Geschichte der Baukunst vom frühesten Alterthum bis in die neuern Zeiten* (Nuremberg, 1827; 2d ed., 1836). **II. Heinrich,** a German poet, nephew of the preceding, born in Arolsen, Feb. 22, 1803, died in Venice, Aug. 24, 1849. He was librarian and teacher at Berlin from 1828 to 1833, when to cure his melancholy he started on a journey with his wife. The latter in 1834 killed herself in the hope that the sudden shock might restore his mental vigor. Her correspondence and diary were edited by Mundt: *Charlotte Stieglitz, ein Denkmal* (1835). Her husband subsequently led a wandering life. His works include *Bilder des Orients* (4 vols., Leipsic, 1831–'3), *Stimmen der Zeit in Liedern* (1832), and his posthumous *Selbstbiographie* and *Erinnerungen an Charlotte* (1865).

**STIEGLITZ, Ludwig von,** a Russian banker, born in Arolsen, Germany, of Jewish parents, in 1778, died in St. Petersburg, March 18, 1843. He was a brother of the medical writer Johann Stieglitz, and in early life went to St. Petersburg. He was poor, but gradually became rich and influential, and at his death left a colossal fortune. He was made a baron in 1825. His brothers Nikolaus and Bernhard also became rich, and one of the latter's sons was made councillor of the ministry of the interior. The son of Ludwig, the baron Alexander, continued the father's business till 1858, when he assumed the direction of the new government bank, retiring in 1866.

**STIGMARIA.** See Coal Plants.

**STILES, Ezra,** an American clergyman, born at North Haven, Conn., Dec. 15, 1727, died in New Haven, May 12, 1795. He graduated at Yale college in 1746, and was a tutor there from 1749 to 1755. He studied theology, and began preaching in June, 1749. He afterward studied law, was admitted to the bar in 1753, and practised at New Haven. In 1755 he became pastor of the second church in Newport, R. I., where, in addition to his professional duties, he engaged in oriental, linguistic, literary, and scientific investigations. His congregation at Newport being broken up by the British occupation of the place in May, 1777, he removed to Portsmouth, N. H., to become pastor of the North church. In September of the same year he was elected president of Yale college, and shortly after professor of ecclesiastical history, and from 1780 was also professor of divinity. He published an "Account of the Settlement of Bristol" (1785), and "History of three of the Judges of Charles I." (1795); and he left an unfinished church history of New England, besides more than 40 volumes of manuscripts. His life has been written by James L. Kingsley, in Sparks's "American Biography," 2d series, vol. vi.

**STILICHO, Flavius,** a Roman general, beheaded Aug. 23, A. D. 408. He was the son of a Vandal officer of the cavalry under the emperor Valens. For his services as an envoy to Persia in 384 Theodosius gave him the hand of Serena, his niece and adopted daughter. Stilicho shortly became master general of the army in the western parts of the empire, and gained several victories over the barbarians. Jealousy between him and Rufinus, whom Theodosius made governor of the East, soon ripened into intense hatred. In 394 Stilicho became governor of the West, as guardian of Honorius, whom Theodosius had proclaimed Augustus. Theodosius died in 395, leaving to Honorius the empire of the West, and to Arcadius that of the East. After crossing the Alps and establishing a firm peace on the border, Stilicho turned toward the East, ostensibly against Alaric, but really to break the power of Rufinus. He was stopped near Thessalonica by a message from the Byzantine court, but engaged Gainas, the leader of the Gothic allies of Arcadius, to put Rufinus to death, which he accomplished, Nov. 27, 395. In 396 Stilicho, without being asked for aid by Arcadius, sailed from Italy against the barbarians, who were ravaging northern Greece and the Peloponnesus; but Alaric escaped into Epirus, of which he took possession. Arcadius ordered Stilicho to leave his territory, and made Alaric master general of the province of Illyricum. In 398 a marriage was celebrated between Stilicho's daughter Maria and Honorius. In 402 Alaric invaded Italy, and Stilicho, collecting his scattered troops from Rhætia, Gaul, and Germany, defeated him at Pollentia (403), and again soon after under the walls of Verona. Alaric then departed, and Stilicho in 404 received the honor of a triumph in Rome. He now formed an alliance with his late enemy against the emperor of the East, promising to pay him a large annual subsidy. In 405 Italy was invaded by Radagaisus, at the head of a multitude of Vandals, Suevi, Burgundians, Alans, and Goths. While they besieged Florence, Stilicho cut off their communications and forced them to capitulate (406). Radagaisus was put to death, and his men were sold as slaves; but the other portion of this horde, which had not entered Italy, ravaged Gaul, from which Stilicho had been obliged to withdraw the garrisons. A large party were indignant at Stilicho's supposed partiality for the barbarians, and especially at the decline of the authority of Rome over Britain, Gaul, and Spain. His power at court was also secretly undermined by the eunuch Olympius, whom he himself had introduced into the imperial palace. The latter represented to Honorius that he was without authority in his own kingdom, and that his death was meditated by Stilicho, who designed placing the imperial crown upon the head of his son Eucherius. While Honorius was at Pavia in 408, through the agency of Olympius, the friends of Stilicho, some of the most illustrious officers of the empire, were murdered. Stilicho was in the camp of the barbarian allies at Bologna, and his friends demanded to be led against the murderers. He hesitated, and his friends left him to his fate. An attempt to assassinate him was made by Sarus, a Goth, but Stilicho escaped and took refuge in a church in Ravenna. From this sanctuary he was led out by Count Heraclian and instantly slain.

**STILLÉ, Alfred,** an American physician, born in Philadelphia, Oct. 30, 1813. He graduated at the university of Pennsylvania in 1832, and was resident physician of the Philadelphia hospital in 1836, and of the Pennsylvania hospital in 1839–'41, having employed the interval in attending medical lectures in Paris and other capitals of Europe. He became lecturer on pathology and practice of medicine to the Philadelphia association for medical instruction in 1844, physician to St. Joseph's hospital in 1849, and afterward professor of the theory and practice of medicine in the Pennsylvania

medical college, and since June, 1864, in the university of Pennsylvania. He has published "Medical Instruction in the United States" (Philadelphia, 1845); "Elements of General Pathology" (1848); "Report on Medical Literature" (1850); "The Unity of Medicine" (1856); "Humboldt's Life and Character" (1859); and "Therapeutics and Materia Medica" (2 vols. 8vo, 1860; revised and enlarged, 1864; 4th ed., 1874).—His brother Moreton (born Oct. 27, 1822, died Aug. 20, 1855), resident physician of the Pennsylvania hospital in 1848–'9, and afterward lecturer to the Philadelphia association for medical instruction, published with Francis Wharton a "Treatise on Medical Jurisprudence" (Philadelphia, 1855; 2d ed., with medical part revised and enlarged by Dr. Alfred Stillé, 1860).

**STILLINGFLEET, Edward,** an English bishop, born in Cranborne, Dorset, April 17, 1635, died in London, March 27, 1699. He was educated at Cambridge, at the age of 18 obtained a fellowship, and in 1657 was presented to the rectory of Sutton. Subsequently he became chaplain in ordinary to Charles II. and dean of St. Paul's, and in 1689 bishop of Worcester. He published "Irenicum, or the Divine Right of particular Forms of Church Government Examined" (1659), manifesting much more toleration than his later works; "A Rational Account of the Grounds of Protestant Religion" (fol., 1664); "Discourse concerning the Idolatry practised in the Church of Rome" (1671); a sermon against the nonconformists entitled "The Mischief of Separation," to the criticisms upon which he replied in a volume entitled "The Unreasonableness of Separation" (4to, 1681); and tracts against Roman Catholics and Socinians. He is best known by his "Origines Sacræ, or Rational Account of the Grounds of Natural and Revealed Religion" (4to, 1662), and his "Origines Britannicæ, or the Antiquities of the British Churches" (1685). When James II. revived the court of ecclesiastical commission, Stillingfleet refused to be a member of it, and after the revolution of 1688 he published a discourse concerning the illegality of the commission. In the latter part of his life he engaged in a sharp controversy with Locke on the latter's definition of substance and theory of ideas in general. His works were printed in 1710 in 6 vols. fol., to which was added in 1735 a volume of his miscellaneous writings.

**STILLWATER,** N. Y. See Saratoga, Battle of.

**STILLWATER,** a city and the county seat of Washington co., Minnesota, on the W. bank of the St. Croix river, 25 m. N. of its junction with the Mississippi, and 16 m. E. N. E. of St. Paul, with which it is connected by two lines of railroad; pop. in 1870, 4,124; in 1875, 5,750. It is the centre of the lumber trade of the St. Croix valley, and contains seven saw mills, a flouring mill, two planing mills, an extensive cooperage and cabinet factory, two national banks, two large public school buildings, the state prison, a public library, three weekly newspapers, and nine churches.

**STILT,** a wading bird of the avocet family, and genus *himantopus* (Briss.). The bill is long, straight, slender, and pointed, with a groove on each side to the middle; wings long and pointed, first quill much the longest; tail short and nearly even; legs very thin and long, with scaled tarsi; toes moderate, joined at the base, with a wide membrane between the outer and middle toes; hind toe wanting; claws small and sharp; neck long. Half a dozen species are found in various parts of the world. The black-necked stilt (*H. nigricollis*, Vieill.) is about 14 in. long, black above, with forehead, lower parts, rump, and tail white; bill black, and legs red. It is found as far N. as the middle states in spring, frequenting salt marshes in small flocks, and going S. beyond the limits of the United States in autumn; the nests are built in company, at first upon the

Black-necked Stilt (Himantopus nigricollis).

ground, from which they are gradually raised by successive additions; the eggs are usually four, of a pale yellowish clay color, with large irregular blotches and lines of brownish black; the flight is rapid and regular, the legs extending behind; the flesh is indifferent eating. The white stilt (*H. melanopterus*, Meyer) is of about the same size, and white, with the back and wings shining greenish black, and legs red; it prefers the edges of fresh-water streams, and is found in S. E. Europe, Asia, and Africa; the bill is 3 in. and tarsus 4 in.

**STIMPSON, William,** an American naturalist, born in Roxbury, Mass., Feb. 14, 1832, died at Ilchester Mills, Howard co., Md., May 26, 1872. He studied under Agassiz, and in 1849 engaged in dredging off the coast of New England. In 1852 he accompanied Agassiz to Norfolk, Va., to investigate the marine fauna of that region. In 1852–'6 he was naturalist to the North Pacific exploring expedition, and in December, 1864, became curator

of the Chicago academy of sciences, and afterward secretary and director of the museum. The great fire of October, 1871, destroyed his collections and manuscripts, embodying the results of 20 years of scientific labor, including his works on the shells of the E. coast, and on the crustacea of North America, with 500 drawings and 200 illustrations already engraved. He passed the winter of 1871-'2 off the Florida coast, till a hæmorrhage of the lungs ended his activity. His works include "A Revision of the Synonymy of the Testaceous Mollusks of New England" (Boston, 1851); "Synopsis of the Marine Invertebrata of Grand Menan," &c. (in vol. vi. of "Smithsonian Contributions to Knowledge," Washington, 1854); "Crustacea and Echinodermata of the Pacific Shores of North America" (Boston, 1857); *Prodromus Descriptionis Animalium Evertebratorum quæ in Expeditione ad Oceanum Pacificum Septentrionalem*, &c. (8 parts, Philadelphia, 1857-'60); "Notes on North American Crustacea" (New York, 1859); and "Researches upon the Hydrobiinæ and Allied Forms" (1865).

**STIRLING,** a town of Scotland, capital of Stirlingshire, on the river Forth, 31 m. W. N. W. of Edinburgh; pop. in 1871, 14,279. It is on a height at the head of the navigation of the river, which is crossed by two bridges and a railway. Many of the public buildings are very ancient. The castle, which stands upon a rocky height 220 ft. above the plain, holds a prominent place in the history of Scotland, and is connected with most of the important events that occurred in that kingdom before it was annexed to England. The ancient royal palace is still standing, and there is also a palace begun by James V. and finished by his daughter Mary. There are several ancient churches and some modern ones, and numerous schools. The town house is very ancient, and the old residence of the earl of Mar is very curious. Stirling has manufactories of woollens, leather, ropes, &c. The river is shallow, but a considerable trade is carried on. The Scottish Central railway passes the town, and three other railways terminate here.

**STIRLING, Earl of.** See ALEXANDER, WILLIAM.

**STIRLING, James Hutchinson.** See p. 898.

**STIRLING, Sir William** (MAXWELL), a Scottish author, born near Glasgow in 1818, died Jan. 15, 1878. He graduated at Cambridge in 1839, and resided several years in Spain. He published "Annals of the Artists of Spain" (3 vols. 8vo, 1848), "The Cloister Life of the Emperor Charles the Fifth" (1852), and "Velasquez and his Works" (12mo, 1855), and edited the marquis de Villars's *Mémoires de la cour d'Espagne sous le règne de Charles II.* (4to, 1862). From 1852 to 1865 he was a member of parliament for Perthshire. In 1866 he succeeded to the baronetcy and estates of his uncle, Sir John Maxwell, and assumed the surname of Maxwell. He was elected rector of the university of St. Andrews in 1863, and of that of Edinburgh in 1872.

**STIRLINGSHIRE,** a central county of Scotland, bordering on the counties of Perth, Clackmannan, Linlithgow, Lanark, and Dumbarton; area, 466 sq. m.; pop. in 1871, 98,218. The chief rivers are the Forth, Avon, Kelvin, Endrick, and Carron. Loch Coulter, Loch Elrigg, and half of Loch Lomond are in the county. Ben Lomond, in the N. W. part, rises 3,192 ft. above the sea. Coal and iron are mined; wool and cotton are manufactured; and there are immense iron works at Carron. The principal towns are Stirling, Falkirk, Alva, Bannockburn, and Denny.

**STOAT.** See ERMINE.

**STOBÆUS, Joannes,** a Greek compiler, probably born at Stobi in Macedonia, lived probably in the 5th century A. D. He made extracts from more than 500 Greek authors, many of whom are not otherwise known to us. The work was early divided into two portions, the one called "Anthology" (*Florilegium*) or *Sermones*, the other "Physical, Dialectical, and Ethical Extracts" (*Eclogæ Physicæ, Dialecticæ et Ethicæ*). The best edition of both portions is that of Meineke (6 vols., Leipsic, 1855-'62).

**STOCK.** See GILLIFLOWER.

**STOCKBRIDGE,** a town of Berkshire co., Massachusetts, on the Housatonic river and railroad, 115 m. in direct line W. of Boston, and 12 m. S. by W. of Pittsfield; pop. in 1870, 2,003; in 1875, 2,089. The surface of the town is varied; in the south is Monument mountain, separating it from Great Barrington, in the west West Stockbridge mountain, in the southeast the Beartown mountains, and in the northwest Rattlesnake mountain. Between these are valleys of great beauty. The Housatonic and its affluents drain the town. The Stockbridge or Housatonic Indians, among whom John Sergeant and Jonathan Edwards labored as missionaries, formerly had their home here, but removed westward in 1788. The villages of Glendale and Curtisville have some manufactures. The village of Stockbridge has a hotel, a bank, an insurance office, an incorporated academy, several private schools, a library, and three churches (Congregational, Episcopal, and Roman Catholic).

**STOCK EXCHANGE,** a place where stocks are bought and sold. In England the term stocks is confined to government stocks, annuities, &c., and the term shares is used for the capital or stock of railroad, banking, and other companies; but in the United States bonds representing national, state, county, and city debts, and the shares of railroads, banks, mining, manufacturing, telegraph, and insurance companies, are all called stocks. In France the word *rentes* has the same limitation as stocks in England. Dealing in stocks, bonds, and annuities is the business of the stock exchange, and the dealers in them are known as stock brokers and stock jobbers. In New York the traffic in stocks is of two kinds, the regular sales at the first and second boards,

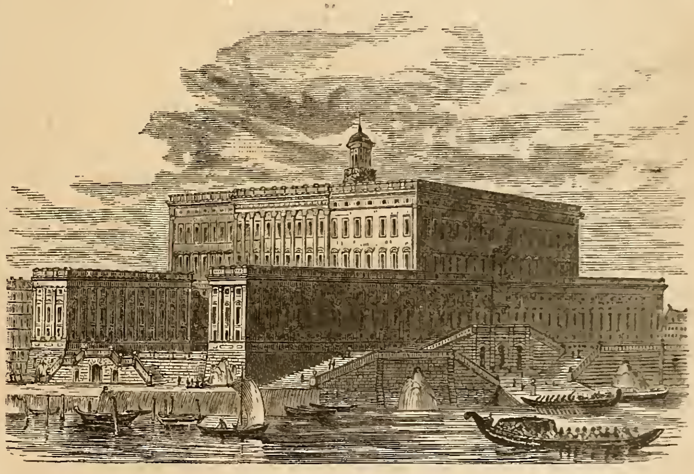
and the operations of the street. The first are legitimate, and the sales are presumed to be *bona fide;* the second are generally speculative, and are often mere gambling or betting by men without capital. The board of brokers in New York is composed of more than 1,000 regular members, who at their two daily sessions, either on their own account or as brokers for others, purchase or sell the various stocks which are called in order. The president, secretary, treasurer, and governing committee of 40 members are the executive of the exchange, and can admit, suspend, expel, and readmit members. Next in importance is the sub-committee of arbitration, which decides all disputes arising from transactions between members. When a member fails to deliver or pay for stocks as agreed, his name is struck from the list; but he may be reinstated upon effecting a settlement with his creditors. The New York stock exchange is the wealthiest organization of the kind in the world. The par value of annual sales made at the boards and "over the counter" is estimated at more than $22,000,000,000; but this enormous sum covers all sorts of speculative transactions, including those where no actual transfer of stocks occurs, and "differences" only are paid or adjusted, these operations forming in fact the bulk of the business in Wall street. The rules of the exchange are very strict, and cover a rigid scrutiny of all securities, a systematization of the brokerage business of member with member, a surveillance over members in respect of their fidelity to contracts, and a stringent examination of the character and responsibility of candidates for membership. An applicant for membership must be 21 years old, a banker, broker, or stock dealer in New York for one year, or a clerk to a member for two years, or a member in good standing of the Philadelphia, Baltimore, or Boston board. The initiation fee of a member admitted by election has recently been fixed at $10,000, and of one admitted by transfer at $500. During business hours the board is in constant communication with the financial centres of Europe, and the brokers pay $1,000,000 a year for telegrams from London alone.—The stock exchange has its own peculiar terms, not generally understood by outsiders. Among those in most frequent use are "long" and "short," expressing individual excess or deficiency in the holding of a specified stock for speculative purposes; and "bull" and "bear," designating those respectively who find their interest in operating for a rise or fall in the price of stocks, or who, foreseeing either a rise or fall, take measures to protect themselves or make a profit on the "turn of the market." The bull endeavors to appreciate or "toss up," and the bear to depreciate or "pull down" the price. The phrase "buyer's option," added to the memorandum of a sale of stocks, implies that the purchaser who buys at 30 or 60 days can call for the delivery of the stocks at any time within the period by giving one day's notice and paying interest at 6 per cent. up to the time he calls. Such purchases are usually made at a little above the cash price. "Seller's option" is a little below the cash price, and the seller has the right to deliver on any day within the limited time, by giving one day's notice, receiving interest up to the time of delivery. A "corner" is an operation by one or several brokers, who form a clique to compel others to pay a heavy difference on the price of stock. Sometimes the clique purchase gradually a large amount of stock on time, buyer's option; they next sell nearly the same amount on time, seller's option, so as to secure an eventual market for their stock; then buy for cash, thus raising the price, and make a sudden call for the stock they have purchased on buyer's option, which, if they have calculated correctly, compels the parties from whom they have purchased to buy of them at a high price in order to deliver at a low one. "A point," the first element of successful speculation, is trustworthy private information concerning a certain stock, such as whether a bull movement is organizing, or an extra dividend is to be declared, or new stock is to be issued, or any other cause is likely to affect the price. A "lame duck" is a broker who is unable to respond with the shares or money when contracts mature. A "spread eagle" is the operation of a broker who sells a large quantity of stock on time, say 60 days, buyer's option, and buys the same quantity at a lower price, on the same time, seller's option. If both contracts run their full time, he makes his difference; but if the buyer or seller calls for a settlement before the time, he may be seriously embarrassed. The "street" or the "curbstone brokers" are not governed by as strict rules, and their operations are mostly speculative. "Put," "call," "ballooning," "saddling," "unloading," and more than 40 other terms make up the dialect of the exchange.—In the Paris *bourse* there are 60 *agents de change*, appointed by the government. Each must deposit 125,000 fr. in the national treasury as a guaranty of upright conduct, and also 100,000 fr. with the syndicate of the bourse as a cautionary fund applicable to losses sustained by the customer through the broker's fault. A broker's seat is worth from 1,500,000 to 2,000,000 fr., and cannot be sold without the consent of the governing committee. There are 60 *courtiers de commerce* and 8 *courtiers d'assurance*, who transact much of their business at the bourse. The *haussiers* and *baissiers* correspond to the American bulls and bears, and the *coulisse* to street or curbstone operators. Cash sales are infrequent, and the greater part of the business is "privilege," technically *marché à prime*, the buyer deciding on the 15th and 30th of the month whether he will take the stock or not, but in either case having to pay the premium. The time transactions are usually "the end of the current month,"

or the end of the next month. The 4th of each month is settling day. The *parquet* is in session from 1 to 3 P. M. every day; the *coulisse* is in session through the day, and it includes a large number of female jobbers and speculators. The London stock exchange numbers nearly 2,000 regular members, who must be reëlected annually. Each member pays £10 yearly, and three members give security to the amount of £300 each for a new member.—The excitement at the hour of "high 'change," in London, Paris, or New York, is often such as beggars description; several hundred men are shouting, calling out what they have to sell or what they wish to buy, at the top of their voices, all together, and leaping and gesticulating, almost as if insane; in speculative periods, immense sums are made or lost in a few minutes. The stock exchanges of Amsterdam, Berlin, Frankfort, Madrid, and Vienna are among those most noted in Europe.

**STOCK FISH.** See Cod.

**STÖCKHARDT, Julius Adolf,** a German chemist, born at Röhrsdorf, Saxony, Jan. 4, 1809. After serving in a pharmacy, he taught natural sciences at Dresden in 1838–'9, afterward at Chemnitz till 1847, and in 1848 was called to the new chair of agricultural chemistry in the academy of Tharand. In 1844 he began a course of lectures before the Chemnitz agricultural society, which led to the establishment of the system of agricultural experimental stations. From 1846 to 1849 he edited *Das polytechnische Centralblatt*, and from 1850 to 1855 (with Schober), *Die Zeitschrift für deutsche Landwirthe;* and in 1855 he established at Berlin *Der chemische Ackersmann*, in which are published his familiar lectures before farmers' clubs and societies, which he calls "field sermons." It is said that the yield of grain in Saxony has been doubled chiefly through his efforts. His principal works are: *Untersuchung der zwickauer Steinkohlen* (1840); *Ueber Erkennung und Anwendung der Giftfarbe* (1844); *Schule der Chemie* (1846; 17th ed., 1873; English translation by G. H. Pence, M. D., "The Principles of Chemistry illustrated by Simple Experiments," Cambridge, Mass., 1850; also by A. Henfrey, London, 1855); *Guanobüchlein* (1851); and *Chemische Feldpredigten* (1851; English translation by J. E. Teschemacher, "Chemical Field Lectures for Agriculturists," Cambridge, Mass., 1853).

**STOCKHOLM,** a city and the capital of Sweden, in lat. 59° 20′ N., lon. 18° 3′ E., 330 m. N. E. of Copenhagen; pop. in 1874, 147,249. It is partly built on islands and intersected by many canals, surrounded on the land side by rocks, forests, and hills, and on the water side by Lake Mælar and the Salt Sjö (Salt lake), an arm of the Baltic. This combination of land and water, together with the magnificent harbor and palace, and other remarkable sights, forms one of the most picturesque panoramas in the world. The city is well built, has several fine squares, and abounds in stately buildings. The royal palace, completed in 1754, consists of a huge quadrangle of solid granite; it is as remarkable for the fitting up of the royal apartments as for its grand and admirable proportions, and the chaste yet massive style of its Italian architecture. It is on the highest and most central of the three islands of the original town, distinctively called the city (*Stad*), and one of



Royal Palace, Stockholm.

the three main metropolitan divisions. These islands have been enlarged by embankments built on piles, whence the name of Stockholm, meaning an island on piles. The other two chief divisions are the northern suburb (*Norrmalm*), the fashionable quarter, and the southern suburb (*Södermalm*), that of the working classes; the former is connected with the city by a fine granite bridge, and the latter by several drawbridges, and there is a new line of railway, with remarkable viaducts and tunnels. The principal government offices and mercantile houses are adjacent to the palace and the quay, and the most elegant stores are in Norrmalm. The building next in beauty to the royal palace is the new national museum, at the S. end of the formerly separate island of Blasiiholm, which is now united to Norrmalm. Its front faces the terrace garden of the royal palace, overlooking the harbor; it is 260 ft. long by 170 ft. broad, and 90 ft. high,

and has three stories filled with interesting collections, soon to include the picture gallery of the palace. A new building has also been provided for the royal or national library of about 70,000 volumes and 4,000 unique manuscripts, which occupied a space extending over nearly the whole S. E. wing of the palace. There are more than 25 places of worship, chiefly for Lutherans, but including several for other Protestants, one for Catholics, one for Swedenborgians, and a new and handsome synagogue. The interior of the church of St. Clara is exceptionally fine. The Swedish kings are crowned in the old St. Nicholas church. The most ancient church is that of Solna, with the tomb of Berzelius, and the most picturesque is the Riddarholm, originally a Franciscan convent and now used as a pantheon. In the latter are the armor of Charles IX., attributed to Benvenuto Cellini, the shrine of Gustavus Adolphus, and that of Charles XII. in the opposite Carolin chapel. Bernadotte is buried in the chapel of the present dynasty, adjoining the Gustavan. Other notable buildings are the governor's palace; the houses of parliament, including the Riddarhus, or house of the nobles and the diet; the royal mint; the exchange; the academy of sciences, with a library of 40,000 volumes, a cabinet of natural history, and a museum with rich zoölogical, mineralogical, and geological collections; the geological and technological institutes; the mining academy, recently removed hither from Fahlun; the new art union and exhibition buildings, with concert rooms; the royal theatre, where Gustavus III. was assassinated in 1792; and the houses in which Swedenborg and other eminent men were born. The most celebrated educational institution is the medical faculty, the principal one in Sweden, attended by a much larger number of students than that at the university of Upsal. A new free university is projected, and there are three gymnasia, various special schools, a military college, and a high school of artillery, the last near the city at Marieberg. No city has a greater variety of rural and waterside pleasure grounds. The most celebrated is the Djurgard or deer park, which occupies almost an entire island opposite the "city," since 1868 united to the metropolitan district. It is about 3 m. in circumference, and contains the Rosendal palace. The Haga park, a little beyond the observatory, opposite the new cemetery, is studded with islands, has water communication between its different parts and the city, and contains a royal palace. The adjacent park of Carlberg is another delightful summer resort. The park known as the Humlegard (hop garden), W. and N. W. of Norrmalm, has been greatly improved; it contains the new library building and large barracks. In Berzelius's park is a monument to Berzelius. Among the other numerous monuments in the city are those to Birger Jarl and to Swedish sovereigns. That of Charles XII. was erected in 1868, opposite the palace in the Kungsträdgard (king's garden) square. Few cities present greater natural beauties than Stockholm, and in the vicinity are many royal and private summer palaces and villas. The city is also the centre of Swedish industry and trade. It has about 300 manufacturing establishments, chiefly of sugar, tobacco, machinery, cast iron, leather, silk, soap, cloth, and porcelain. It is the principal Swedish port of entry. The imports in 1874 amounted to about $50,000,000, and the exports to $30,000,000; and the customs receipts reached nearly $6,000,000. The entries of British ships alone comprised 38 steamers and 161 sailing vessels. The total inward shipping in the foreign trade includes over 1,500 vessels, besides nearly 10,000 in the coasting trade, and about 60 local steamers. The exports to the United States in 1873-'4, chiefly iron, were valued at $1,063,997 in gold. The harbor accommodates the largest vessels, and is defended by a fortress.—The reputed founder of Stockholm was Birger Jarl, the father and guardian of Waldemar, elected king in 1250. A settlement had been in existence at the spot since the destruction of Sigtuna by Finnish pirates in 1187. It was a powerful stronghold against the devastations of the pirates in all the towns along Lake Mælar, and was frequently besieged. Stockholm became the residence of the Swedish monarchs soon after Birger's death, though Upsal continued long afterward to be the seat of government. With Lübeck and Hamburg reciprocity of free trade was established, and soon after with Riga. In 1501 the citadel was held against insurgents by Christina, queen of Denmark, whose husband, King John, ruled over the three united kingdoms of Scandinavia. King John had left his queen in command of a garrison of 1,000 men, whose number, after a siege of eight months, was reduced to about 80. She was compelled to capitulate, May 27, 1502. A still more heroic defence against the Danes under Christian II. was made by Christina Gyllenstjerna, the widow of the fallen regent Sten Sturé. After a terrible siege of four months, the place was surrendered, Sept. 7, 1520, with the solemn guarantee of the king to respect the rights of the inhabitants. A fearful massacre ensued, known as the "blood bath of Stockholm." Many treaties have been signed here in modern times; in 1855 that with the western powers guaranteeing the integrity of Swedish territories.

**STOCKING**, a close-fitting garment for the foot and leg, usually knit or woven. From paintings found at Pompeii, as also from notices in some of the Latin classics, it appears that stockings were known to the Romans in the latter days of the republic and under the empire; but they formed no part of the ordinary costume. *Fasciæ*, bandages wound round the leg from the ankle to the knee, were sometimes worn by persons in delicate health, or as a pro-

tection to the legs when walking through briers, as in hunting, on the march, &c. The art of knitting stockings is usually said to have originated in Scotland in the early part of the 16th century. In the times of Elizabeth it was an important industry in England, and the queen's government refused letters patent to William Lee, the inventor of the stocking frame (1589), on the ground that the machine-made goods would drive the home-made out of the markets and ruin the workpeople. Lee took his machine to France, and established a factory at Rouen, where he employed a number of his own countrymen. Political troubles soon drove him out of Rouen, and he died on the way to England. His brother introduced the manufacture into Nottinghamshire, which has ever since been famous for its production of stockings. Stocking frames were introduced into the United States in the 18th century at Philadelphia and Germantown, Pa., New York city, and several places in the middle and eastern states. The adaptation of the Lee machine to power was first accomplished by Timothy Bailey of Albany in 1831; and the first machine thus run was at Cohoes, N. Y., in 1832. The old Lee invention was a square frame, producing a straight strip, which was cut off in proper lengths, and seamed together to form the stocking. But a great improvement upon this, the origin of which is unknown, was the circular loom in which a continuous circular web is knit of any length, which is cut up and formed into the shape of a stocking. Several others have since been devised in the United States for manufacturing purposes, as also for family use.—The various knitting machines, which are too numerous to be mentioned in detail in this article, produce what is called the stocking stitch or chain work, consisting of loops formed in succession upon a single thread, each one locked by that which follows it. These machines may be distinguished by the different kinds of needles they employ, and also by the manner in which these are arranged: whether on a straight horizontal line, all pointing the same way, as in the common stocking loom, or around an open horizontal circle, all pointing toward the centre. The latter are known as the rotary round machines. Every needle is hooked at the end, so as to hold the thread laid across it that is to form the next loop, while the loop previously formed on the same needle slips back on the shank as the needle is pushed forward, and with its return runs over the hook and off the end. The contrivance by which this is effected distinguishes the several needles. In the straight frames the work is done first across the needles in turn in one direction and then back in the other, and so on; but in the rotary round machines the revolution carries the needles constantly round in the same direction, each one taking up the thread in turn, and so rapidly that the movements cannot be clearly perceived. The one class of machines produces a flat web, and the other a tubular one, each of which hangs from the needles and is drawn down as it lengthens by means of a weight. The number of stitches or loops which each machine can form in a minute varies with the gauge of the needles or the distance apart at which they are set. The machines constructed for family use, and worked by a treadle or crank like a sewing machine, make about half as many stitches as the factory machines. In the factory three or four machines are easily tended by one boy. Ribbed work is performed in the same machines by bringing in play a set of vertical needles, so arranged as to work in connection with the horizontal and produce the additional stitches required. As the needles are set to a particular gauge, they necessarily produce the same number of stitches to the inch; and the only variations practicable in the work are in using yarns or threads of different degrees of fineness, and in altering the tension so as to make the work closer or more open.—The shaping of the web to fit the foot is a matter of no little ingenuity. The flat web is either knit in long strips of sufficient width to make when turned over several stockings which are cut out from these; or the web is at once knit upon the machine in the shape required for making a stocking when the parts are properly folded over. In the latter the wider part, when turned over and fastened, forms the leg of the stocking. Two narrow strips at the base of this part, turned under and joined together, form the heel; while a central strip twice the length of the foot, being turned over at the toe, forms the top and bottom of the foot, and is neatly united to the heel and around its edges by knitting or seaming. In forming the foot to the cylindrical webs, a slit is made above the heel half across the web, which admits of the part designed for the foot being curved out at the instep. The loops along the edges of the cut are then taken up on hand needles, and the space for the heel is filled out by hand knitting. In the same manner the toe is completed; and thus the stocking is finished without a seam.—Notwithstanding the large number of machines employed in knitting, stockings are still largely produced by the old method of hand knitting, which admits of the use of a harder and firmer yarn than that adapted to the machines; and even where the machine work is produced in large mills employing steam power, the hand looms are also in extensive use, many of them in the houses of the operatives. In the factories the knitting machines are also made to produce many other articles of apparel, as undershirts, drawers, comforters, scarfs, opera hoods, talmas, nubias, gloves, mits, &c. The total production of this class of goods (hosiery) in the United States in 1870 amounted to $19,871,254; number of hands employed, 14,105. Nearly the whole amount was produced in the following states: New York, $5,528,742; Pennsylvania, $5,306,738; Massachusetts, $3,213,481; New Hampshire, $1,757,445; Connecticut,

$1,251,742; New Jersey, $568,900; Vermont, $551,129; and Rhode Island, $137,000.

**STOCKMAR, Christian Friedrich**, baron, a German physician, born in Coburg, Aug. 22, 1787, died there, July 9, 1863. He practised medicine at Coburg, and in 1814-'15 in the army. In 1816 he became physician to Prince Leopold, and soon afterward his private secretary, and was comptroller of his household till after his accession in 1831 to the Belgian throne. Subsequently Leopold sent him to London to assist the princess and future queen Victoria with his advice. In 1836 he arranged the marriage of Prince Ferdinand of Coburg with Queen Maria II. of Portugal, and in 1837 accompanied Prince Albert to Italy. He was the trusted friend of the Coburg princes and other high personages, especially of Queen Victoria and Prince Albert, to whom he made a long visit every year till 1857. In 1858 he aided in the negotiations for the marriage of the present crown prince of Prussia with the English princess royal. The latter designed the monument erected to him at Coburg. He received the title of baron from several sovereigns. —See *Denkwürdigkeiten aus den Papieren des Freiherrn Christian Friedrich von Stockmar*, by Ernst von Stockmar (Brunswick, 1872; English translation, edited by Max Müller, "Memoirs of Baron Stockmar," 2 vols., London, 1873).

**STOCKPORT**, a town of Cheshire, England, at the junction of the Mersey and the Thame, 5 m. S. E. of Manchester; pop. in 1871, 53,014. It stands upon a hill, and the houses rise above each other in irregular tiers. The Mersey is crossed by five bridges, and there are several suburbs, the most extensive of which are Heaton-Norris, Edgeley, and Portwood. The principal public buildings are the barracks, court house, union workhouse, and the building for the Sunday school, which is attended by nearly 4,000 children. A magnificent railway viaduct of 26 arches spans a portion of the town as well as the river Mersey. The former extensive manufacture of silk has been supplanted by that of cotton, for the spinning and weaving of which there are in the town and suburbs about 100 factories. There are also establishments for bleaching, dyeing, and printing cotton, brass and iron founderies, &c. Rich coal mines are worked in the vicinity.

**STOCKTON**, a city and the capital of San Joaquin co., California, on a level prairie at the head of Stockton slough, a wide and deep arm of the San Joaquin river extending E. from that stream for about 3 m., and on the Central Pacific railroad, 63 m. (direct) E. by N. of San Francisco; pop. in 1860, 3,679; in 1870, 10,066, of whom 4,102 were foreigners, including 1,076 Chinese; in 1875, estimated at 14,000. The Stockton and Copperopolis railroad extends to Milton, Calaveras co., 30 m., and from it branches the Stockton and Visalia railroad, extending to Oakdale, Stanislaus co., 34 m. from Stockton. The Visalia division of the Central Pacific railroad, branching from the main line 9 m. W. of the city, runs S. through the San Joaquin valley for nearly 200 m. A narrow-gauge railroad to Ione City, Amador co., about 40 m., will render available the immense coal deposits of that county. Stockton has a good harbor, and the river is navigable to this point from San Francisco at all seasons by vessels of from 150 to 250 tons. In the winter and spring steamers ascend nearly 200 m. above the city. The business blocks are principally of brick. The court house and city hall, near the centre of the city, is surrounded with choice shade trees and shrubbery, as are also many of the residences. Several of the churches are costly structures. The city is lighted with gas, and is supplied with water through pipes from three artesian wells. It has a volunteer fire department, and a horse railroad. The business of Stockton consists chiefly in furnishing supplies to the farmers of the San Joaquin valley and in the shipment of wheat, wool, and other produce. The shipments of wheat for the three years 1873-'5 averaged nearly 3,500,000 bushels, valued at about $3,000,000. The city contains four banking institutions, with an aggregate capital of $1,650,000, including a national gold bank and a savings and loan society. There are two manufactories of carriages, three of agricultural implements, two of sash, blinds, &c., one of paper, several of boots and shoes, saddlery and harness, furniture, tinware, &c., two flouring mills, two iron founderies, three tanneries, and three breweries. Considerable wine is also made here. Stockton is the seat of the state lunatic asylum. It has a high school and 33 other public schools of different grades, three newspapers, each having daily and weekly editions, and 12 churches, viz.: 2 Baptist, 1 Congregational, 1 Episcopal, 1 German Reformed, 1 Jewish, 3 Methodist, 2 Presbyterian, and 1 Roman Catholic. The city was laid out in 1849 and incorporated in 1850.

**STOCKTON. I. Richard**, a signer of the Declaration of Independence, born near Princeton, N. J., Oct. 1, 1730, died there, Feb. 28, 1781. He graduated at the college of New Jersey, at Newark, in 1748, was admitted to the bar in 1754, became a member of the executive council of New Jersey in 1768, and in 1774 a judge of the supreme court. In 1776 he was elected to congress, and served on the committee appointed to inspect the northern army. After his return to New Jersey he was captured by the British, confined in the common prison at New York, and treated with such severity as ultimately to cause his death. **II. Robert Field**, an American naval officer, grandson of the preceding, born in Princeton, N. J., in 1796, died there, Oct. 7, 1866. He entered the navy in 1810, became a lieutenant in 1814, and in 1821 went to Africa in command of the Erie, and aided the colonization society in procuring the territory forming the present republic of Liberia. On his return he was sent to the West Indies against the pirates. For several

years he took an active part in politics as a partisan of Gen. Jackson. In 1838 he served as flag officer in the Mediterranean, and in 1839 was made a captain and recalled. He was one of the earliest advocates of a steam navy, and drew the plans for the steam sloop of war Princeton, built at Philadelphia in 1842–'4, the explosion of one of the guns of which at Washington in 1844 caused the death of five persons, including the secretaries of war and the navy. In October, 1845, he was sent to the Pacific coast, where he took command, and in the following year conquered California and established the authority of the United States, returning overland in 1847. In 1849 he resigned his commission, and in 1851 was elected United States senator. He promoted the abolition of flogging in the navy, and resigned in 1853. His "Life, Speeches, and Letters" was published in 1856 (New York).

**STOCKTON, Thomas Hewlings,** an American clergyman, born at Mount Holly, N. J., June 4, 1808, died in Philadelphia, Oct. 9, 1868. He studied medicine in Philadelphia, but became a Methodist Protestant preacher, and was stationed at Baltimore in 1830. He was chaplain of the house of representatives from 1833 to 1835, and again from 1859 to 1861, and of the senate in 1862. In 1850–'55 he was associate pastor of St. John's Methodist church in Baltimore, and from 1856 of the church of the New Testament in Philadelphia. He compiled and published a Protestant Methodist hymn book, and issued the New Testament in paragraph form, and editions of the Bible, each book by itself. His other works include "Floating Flowers from a Hidden Brook" (Philadelphia, 1844); "The Bible Alliance" (Cincinnati, 1850); "Ecclesiastical Opposition to the Bible" (Baltimore, 1853); "Sermons for the People" (Pittsburgh, 1854); "The Blessing" (Philadelphia, 1857); "Stand up for Jesus," a ballad with notes, illustrations, and music, and a few additional poems (Philadelphia, 1858); "Poems, with Autobiographical and other Notes" (1862); "The Peerless Magnificence of the Word of God" (1862); "Influence of the United States on Christendom" (1865); and from his manuscript, after his death, "The Book Above All" (1870).—See "Memory's Tribute to the Life, Character, and Work of Rev. Thomas H. Stockton," by the Rev. A. Clark (New York, 1869), and "Life, Character, and Death of Rev. Thomas H. Stockton," by the Rev. J. G. Wilson (Philadelphia, 1869).

**STOCKTON-UPON-TEES,** a town of Durham, England, on the left bank of the Tees, 10 m. from its mouth in the North sea, and 220 m. N. N. W. of London; pop. in 1871, 27,598. The river is crossed by a fine bridge. The principal public buildings are the custom house, town hall, borough hall, mechanics' institute, and theatre. It is an important railway centre, and several branch lines bring in the produce of the numerous coal and lead mines in the vicinity. It has considerable commerce, and vessels of 300 tons can come up to the quays. The manufactures comprise sail cloth, rope, linen and worsted yarns, and iron and brass work, and there are ship yards, breweries, brick kilns, and corn mills.—Stockton was early a place of importance, and was the residence of the bishops of Durham. In 1325 it was ravaged by the Scots. In 1644 it was taken by the Scottish army, and in 1652 the castle was demolished.

**STODDARD,** a S. E. county of Missouri, bounded W. by the St. Francis and drained by the Castor river; area, about 800 sq. m.; pop. in 1870, 8,535, of whom 70 were colored. The greater portion of the county is level, and there are swamps and shallow lakes, the principal of the latter being Lake Nicormy, 25 m. long and 4 m. wide. It is a part of the "sunk country" produced by the earthquake of 1811. Large forests of cypress abound. It is intersected by the Cairo, Arkansas, and Texas division of the St. Louis and Iron Mountain railroad. The chief productions in 1870 were 34,501 bushels of wheat, 384,051 of Indian corn, 17,259 of oats, 29,708 of potatoes, 118,534 lbs. of tobacco, 9,138 of wool, 37,688 of butter, and 11,991 gallons of sorghum molasses. There were 2,295 horses, 2,560 milch cows, 1,286 working oxen, 4,206 other cattle, 6,765 sheep, and 26,558 swine. Capital, Bloomfield.

**STODDARD. I. Richard Henry,** an American author, born in Hingham, Mass., in July, 1825. His father, a sea captain, was early lost on a voyage, and the son for several years worked in an iron foundery in New York. In 1849 he privately printed a volume of poems, entitled "Footprints," followed by a maturer collection of "Poems" in 1852. In the latter year he received an appointment in the New York custom house, which he held till 1870. In 1853 he published "Adventures in Fairy Land," a book for young people, and in 1857 "Songs of Summer." His other works are: "Town and Country, and the Voices in the Shells," for children (New York, 1857); "Life, Travels, and Books of A. von Humboldt," with an introduction by Bayard Taylor (Boston, 1860; London, 1862); "The King's Bell," a poem (Boston, 1862; London, 1864; New York, 1865); "The Story of Little Red Riding Hood," in verse (New York, 1864); "The Children in the Wood," in verse (1865); "Abraham Lincoln, a Horatian Ode" (1865); "Putnam the Brave" (1869); and "The Book of the East," containing his later poems (1871). He has edited "Gen. Lyon's Political Essays, with his Life" (New York, 1861); "The Loves and Heroines of the Poets" (1861); J. G. Vassar's "Twenty-one Years round the World" (1862); "Madrigals, mostly from the Old English Poets" (1865); "The Late English Poets" (1865); a new edition with additions of Griswold's "Poets and Poetry of America" (1872), and of his "Female Poets of America" (1874); and the "Bric-à-Brac Series" (1874 *et seq.*). **II. Elizabeth** (Barstow), wife of the preceding,

born in Mattapoisett, Mass., in 1823. Since her marriage in 1852 she has published three novels, "The Morgesons" (1862), "Two Men" (1865), and "Temple House" (1867), all descriptive of New England life and scenery, and has assisted her husband in the editing of two or three annuals.

**STODDARD, Solomon**, an American clergyman, born in Boston in 1643, died in Northampton, Mass., Feb. 11, 1729. He graduated at Harvard college in 1662, was appointed "fellow of the house," and was the first librarian of the college from 1667 to 1674. In 1669 he became minister at Northampton, and was ordained Sept. 11, 1672. In February, 1727, Jonathan Edwards, his grandson, was elected as his colleague. In 1700 he published "The Doctrine of Instituted Churches," as an answer to the work of Increase Mather entitled "The Order of the Gospel," which occasioned an exciting controversy. He maintained that the Lord's supper is a converting ordinance, and that all baptized persons, not scandalous in life, though consciously unconverted, may lawfully partake of it. He also wrote "A Guide to Christ" (1714); "The Safety of appearing in the Day of Judgment in the Righteousness of Christ," which was reprinted at Edinburgh in 1792; and "The Trial of Assurance" (1796).

**STOICS** (Gr. *στοά*, porch), or philosophers of the porch, one of the speculative schools of antiquity, so called from the place at Athens (*στοά ποικίλη*) in which their founder Zeno gave his instructions (about 300 B. C.). Of their earlier representatives, besides the founder, the most prominent were Ariston of Chios, Cleanthes, Chrysippus, Zeno of Tarsus, Persæus, Herillus of Carthage, Sphærus, Diogenes the Babylonian, Antipater of Tarsus, and Posidonius and Panætius of Rhodes (about 130 B. C.); of their later, Seneca (died A. D. 65), Epictetus, Annæus Cornutus, Persius Flaccus, Musonius Rufus, Arrian, Marcus Aurelius, and many of the most distinguished Roman citizens. Originally treating the three departments of logic, physics, and ethics, they are chiefly known as moralists, since they connected philosophy intimately with the duties of practical life. In logic, they found the criterion of knowledge in sensuous impressions, which furnish the materials fashioned by reason, and combated skepticism by affirming that every representation of an object implies the existence of the object itself. In physics, they regarded God and the world as power and its manifestation, matter being a passive ground in which dwells the divine energy. Their ethics was a protest against moral indifference, and to live in harmony with nature, conformably to reason and the demands of universal good, and in the utmost indifference to pleasure, pain, and all external good or evil, was their fundamental maxim. (See MORAL PHILOSOPHY, vol. xi., p. 809.) An attempt to revive the stoic philosophy was made by Justus Lipsius (1547–1606), especially in his *Manuductio ad Stoicam Philosophiam* and *Physiologia Stoicorum.*—See Tiedemann, *System der stoischen Moral* (1776); Dourif, *Du Stoïcisme et du Christianisme* (Paris, 1863); O. Reichel, "The Stoics, Epicureans, and Skeptics" (translated from Zeller's *Philosophie der Griechen*, London, 1869); Weygoldt, *Zeno von Citium und seine Lehre* (Jena, 1872); and Wellmann, *Die Philosophie des Stoikers Zenon* (Leipsic, 1873).

**STOKES**, a N. county of North Carolina, bordering on Virginia, and drained by a branch of the Dan river; area, 550 sq. m.; pop. in 1870, 11,208, of whom 2,608 were colored. The surface is hilly and the soil fertile. Iron ore is abundant. The chief productions in 1870 were 33,450 bushels of wheat, 11,948 of rye, 171,214 of Indian corn, 36,353 of oats, 11,246 of Irish and 9,953 of sweet potatoes, 844,145 lbs. of tobacco, 6,381 of wool, 46,325 of butter, 37,050 of honey, and 7,421 gallons of sorghum molasses. There were 916 horses, 504 mules and asses, 4,928 cattle, 5,482 sheep, and 12,132 swine. Capital, Danbury.

**STOKES, George Gabriel**, a British mathematician, born in Skreen, Ireland, Aug. 13, 1819. He graduated at Cambridge in 1841, and was elected a fellow of Pembroke college. In 1849 he was appointed Lucasian professor of mathematics in the university. In 1851 he was chosen fellow of the royal society, and in 1852 contributed to its "Transactions" his celebrated paper "On the Change of the Refrangibility of Light," which gained the Rumford medal. He was elected president of the British association in 1869. He has published many papers on questions in pure mathematics and physics, particularly on the theory of light.

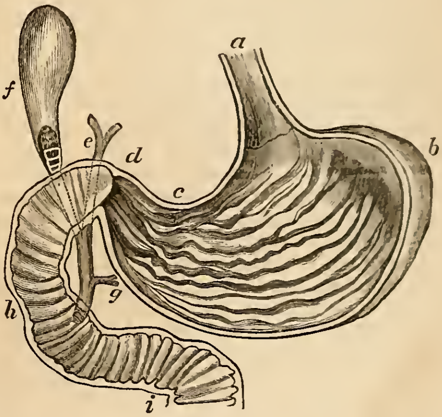
**STOKE-UPON-TRENT**, a parliamentary borough, town, and parish of Staffordshire, England, on the river Trent, 134 m. N. W. of London; pop. of the parish (including Hanley and other towns) in 1871, 89,262; of the parliamentary borough, 130,985. The town is the centre of "the Potteries," is well built, with numerous wharves and warehouses, and is intersected by the great trunk Trent canal and the North Staffordshire railway. Pottery is the principal manufacture, employing a large proportion of the population, and the place is famous for its china, porcelain, statuettes, and ornamental and encaustic tiles.

**STOLBERG. I. Friedrich Leopold**, count, a German poet, born at Bramstedt, Holstein, Nov. 7, 1750, died near Osnabrück, Dec. 5, 1819. After the death of his father, the Danish chamberlain Count Christian Günther, who was the first of his rank to liberate his serfs, his mother imparted a strong religious bias to his education. From 1770 to 1772 he studied at Halle, and subsequently at Göttingen, where he and his brother became prominent members of the *Dichterbund*. In his travels in 1775 he was with Goethe at Frankfort and other places, and next at Weimar, where he accepted an office at the court; but Klopstock

prevailed upon him to enter the service of the prince-bishop of Lübeck, who in 1777 sent him as envoy to Copenhagen. He married Anna von Witzleben in 1782, and resided at Eutin, where through his influence Voss became rector. In 1786 he was transferred to an office at Neuenburg in Oldenburg. After his wife's death in 1788 he sought solace in the society of the count and countess Reventlow at Emkendorf, and their influence made him more orthodox. Soon afterward he was appointed Danish ambassador at Berlin, and in 1790 he married the countess Sophia von Redern. He was appointed by the prince-bishop district governor at Eutin, but obtained leave of absence, and visited Münster, where he became acquainted with the ultramontane princess Amalia Gallitzin, and afterward Rome, where his growing partiality for Catholicism was greatly increased. Seven years later he and his whole family, excepting his elder daughter, formally joined the Catholic church (June 1, 1800). This alienated him from many of his former friends, especially from Voss, and his conversion influenced that of the younger Schlegel and the tone of other writers of the romantic school. He resigned his office at Eutin in the same year, and resided at Münster till 1812, when the surveillance to which his censure of the government subjected him drove him to a secluded locality near Bielefeld, and in 1816 he removed to his Hanoverian domain of Sondermühlen. His poetical works form the largest portion of the *Werke der Brüder Stolberg* (22 vols., Hamburg, 1821–'6). Among his other works are *Die Insel*, a prose romance developing the Utopian scheme of a model republic, dramas with choruses, translations of the Iliad and of parts of Plato, Æschylus, and Ossian, and *Geschichte der Religion Jesu Christi* (15 vols., Hamburg, 1811–'18; continued by Fr. Kerz to vol. xlv., Mentz, 1825–'46, and by Brischar to vol. lii., 1849–'59).—See *Der Graf Friedrich Leopold von Stolberg und seine Zeitgenossen*, by Menge (2 vols., Gotha, 1862). **II. Christian,** count, brother of the preceding, born in Hamburg, Oct. 15, 1748, died near Eckernförde, Schleswig, Jan. 18, 1821. He was associated with his brother at Göttingen, and shared in many of his poetical and other labors. He held an office at Tremsbüttel, Holstein, from 1777 to 1800. His wife, originally countess of Reventslow, figures in his poems as his beloved Louisa.

**STOLPE,** or **Stolp,** a walled town of Prussia, in the province of Pomerania, on the navigable river Stolpe, 10 m. from its mouth at the port of Stolpemünde on the Baltic, and 125 m. N. E. of Stettin; pop. in 1871, 16,280. It has a castle, three churches, a gymnasium, two hospitals, a house for invalids, and manufactures of amber, wool, linen, copper, hats, starch, tobacco, and leather.

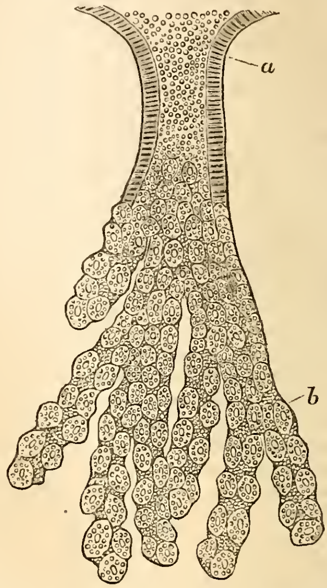
**STOMACH,** the hollow organ in which the first part of the function of digestion is performed in every perfectly developed animal. As a general rule, throughout the vertebrate animals we find a complex stomach associated with a vegetable diet; but this has striking exceptions, as in the dolphin, which has a multiple stomach with an animal diet, and the horse, which has a simple stomach with the same vegetable food as the ox. In man the stomach is the widest and most dilatable part of the alimentary canal; it is in the upper part of the abdomen, in the epigastric and part of the left hypochondriac region, below the diaphragm, above the arch of the colon and transverse mesocolon, and to a certain extent between the liver and spleen; it comes in contact in front with the anterior wall of the abdomen, and behind with the organs and vessels lying upon the spine. Its shape varies greatly, but when moderately distended, in or out of the body, resembles a bent cone, curved from before backward and from above downward, following its length; it lies almost transverse,




The Human Stomach laid open.—*a*. The œsophagus. *b*. The cardiac dilatation or great pouch. *c*. The lesser curvature. *d*. The pylorus. *e*. The hepatic duct. *f*. The gall bladder. *g*. The pancreatic duct, opening, together with the common biliary duct, into the duodenum. *h i*. The duodenum.

a little obliquely downward, forward, and to the right; the anterior border is the greater curvature, and is lodged between the folds of the great omentum; the œsophagus enters at about one quarter of the length from the left extremity; the great *cul-de-sac* on the left is united to the spleen by short vessels. The "pylorus" is the constriction between the smaller extremity of the stomach, directed toward the right, and the commencement of the duodenum. The average capacity of the stomach is regarded as about five pints; but this varies very much according to the age and habits of the individual, and even according to the alternating conditions of fulness or vacuity. When filled with food, the stomach becomes more horizontal, so that its great curvature looks forward and its lesser curvature backward.—The stomach is composed of four distinct coats or tunics: 1. The external or peri-

toneal coat is a thin serous layer covering the outside of the organ, continuous with the general peritoneal layer of the abdomen. Its moist and smooth external surface enables the stomach and other neighboring organs to glide readily over each other without friction or injury. 2. The muscular coat, immediately beneath the peritoneal covering, is composed of a double series of circular and longitudinal muscular fibres, of the smooth or unstriped variety, whose involuntary alternating contractions and relaxations cause the peristaltic movements of the walls of the stomach, and provide for the requisite mixture, transportation, and final expulsion of its contents. 3. The submucous cellular coat is a layer of loose areolar tissue, between the muscular coat and the mucous membrane. The office of this layer is to form such a connection between the muscular and mucous tunics as to keep them in a certain degree of apposition, and yet allow of the folding up of the mucous membrane when the organ is empty, and its expansion when filled with food. 4. The mucous membrane of the stomach, its most important tunic in a physiological point of view, is the membrane which secretes the gastric juice. Its internal surface is soft and velvety, owing to its being covered with minute conical folds or ridges which are partly distinct and partly connected with each other. Its thickness is composed of a great number of tubular glands or follicles, the "gastric tubules," which begin at the inferior portion of the mucous membrane by blind extremities, run perpendicularly through its substance, and open by minute orifices upon its free surface into the general cavity of the stomach. These tubules vary somewhat in different parts of the stomach. In the pyloric or right-hand portion they are nearly straight and simple in structure, and of the same diameter throughout. In the cardiac or left-hand portion they are more compound, several of them uniting, at a little distance below the surface, into comparatively wide circular tubes, lined with cylindrical instead of glandular epithelium. In the middle region of the stomach the gastric glands are also compound; and their inferior or tubular portions, which are here very long, are filled, in addition to the ordinary glandular epithelium, with very large, rounded, granular, nucleated cells, which often seem to fill nearly their entire cavity, and to project from their sides in such a way as to give them an irregularly tumefied or varicose appearance. The mucous membrane of the stomach is exceedingly vascular, the capillary blood vessels penetrating everywhere between the adjacent tubules, and forming an abundant superficial plexus about their orifices. At the time of digestion the quantity of blood circulating in the mucous membrane is greatly increased by an expansion of the smaller arteries supplying the capillary network. The mucous membrane becomes turgid and reddened, the gastric tubules enter into a state of functional activity and begin to pour out the gastric juice, which is to act upon the food. Soon afterward the muscular coat of the organ is in its turn excited to peristaltic action, by which the food is



Compound Gastric Tubule, from the middle region of the Stomach. *a*. Upper or wide portion, lined with cylindrical epithelium. *b*. Lower or tubular portion, lined with glandular epithelium.

moved alternately to and fro, from the cardiac toward the pyloric extremity of the organ, and subjected also to a kind of gentle and continuous churning process by which the gastric juice exuded from the mucous membrane is made to penetrate every part of the alimentary mass, and come in contact simultaneously with the whole. As digestion proceeds, successive portions of the liquefied food are carried through the pylorus into the small intestine; and as the stomach is thus gradually emptied it resumes its previous condition of repose. The peristaltic motion comes to an end, the vascular congestion subsides, and the further secretion of gastric juice is suspended until the next period of digestion arrives.

**STOMACH, Diseases of the.** Diseases of the stomach may be classed as inflammatory, structural, and functional. Gastritis or inflammation of the stomach may be acute, subacute, or chronic. It is always attended by certain symptoms, but they are also mostly the symptoms of other diseases. Vomiting is frequent and persistent, but is of itself not sufficient evidence, nor when associated with pain in the epigastric region. The following combination of symptoms may be considered as diagnostic: intense pain of a burning character over the epigastrium, together with shooting pains in the chest, unaccompanied by the physical signs of pulmonary disease, nausea, and

vomiting of muco-serous matter tinged with bile and often with blood, the act causing intense suffering. The thirst, though not always present, is often so great as to be almost insupportable. The pulse is frequent, small, and wiry. The temperature of the skin is generally considerably raised. The bowels are constipated except in cases of poisoning.—Acute gastritis is caused by traumatic injuries and by irritant poisons; also by excessive indulgence in alcoholic drinks. Over-eating and the eating of indigestible food are also causes. The treatment does not involve much medication; rest, cooling drinks, light bland food, and the administration of nourishing enemas with sometimes small quantities of opiates, are the chief reliances. Lime water and milk may sometimes be taken better than almost anything else. Wine may be given by the mouth or spirits by the rectum.—Subacute gastritis is generally more or less transient. When attended with considerable fever, the affection is sometimes called "gastric fever;" but this term is indefinite, and is also applied to cases of what are called "abortive typhoid fever," in which the symptoms for the first few days are like those of typhoid fever and then cease. It is often the consequence of errors in diet, either of over-eating or of eating improper food, and frequently follows a debauch. There is tenderness in the epigastric region and a furred tongue. Pain in the head is often a prominent symptom, frequently accompanied by nausea. The pulse is usually feeble and the extremities cold. If the inflammation approaches the acute character, the symptoms are heightened in proportion. Rest, abstinence from food for a time, bland and nutritious diet, regulation of the intestinal evacuations by enemas, the application of sinapisms or other counter-irritants or of warm water dressings over the epigastrium, and the administration of demulcents, as flax-seed tea, and also small pieces of ice, are ordinarily indicated. Subacute gastritis is frequently connected with acute dyspepsia, in which case it is often designated by the indefinite term "bilious attack," although the term is generally an improper one, as the liver is not usually particularly implicated. There is congestion of the mucous membrane of the stomach, in which that of the intestines finally participates, with active diarrhœa and sometimes severe colic. The treatment includes the unloading of the stomach and bowels, with sometimes the administration of anodynes, particularly chloroform.—Chronic gastritis may come on gradually, or it may follow the acute or subacute form. Its symptoms are liable to be mistaken for those of functional disorder which constitute dyspepsia. The causes are errors in diet, poisonous or irritating substances, excessive drinking of alcoholic liquors, poverty of the blood, irregularity in the circulation, and diseases of other organs. The treatment is rest of the organ, gentle exercise of the body, nutritious but easily digestible food, tonics, counter-irritants, bathing with after friction of the skin, and sometimes the administration of pills of nitrate of silver or of powders of subnitrate of bismuth.—The structural diseases of the stomach are induration, softening, ulceration, cancer, degeneration of the gastric follicles, and dilatation. Induration or sclerosis of the stomach is due to a morbid fibrous growth in the submucous areolar tissue, involving thickening of the coats of the organ. It is probably caused by chronic inflammation of the submucous areolar tissue. The affection may involve a part or the whole of the organ. When limited in extent the pylorus is the part usually affected, a condition liable to produce stricture and render the case dangerous from retention of food. It is a rare affection, scarcely ever attacking those who are under 40 years of age. Its symptoms are liable to be mistaken for those of cancer, but its long continuance without the rapid progress of cancerous disease, and also its appearance in other organs, are diagnostic. It is generally regarded as chiefly occurring in hard drinkers. The treatment is abstinence from spirits and other stimulants, and a nutritious and well regulated diet.—Softening of the stomach may be the result of inflammation, but there are cases of non-inflammatory origin. The softening may be confined to the mucous coat, or it may involve all the others. Non-inflammatory softening is probably sometimes caused by defective nutrition of the membrane.—Ulceration of the stomach is one of the sequelæ of acute gastritis, but it may follow inflammation limited to the space of the ulcer. The ulcer varies in size, sometimes being so small as not to be easily found, or it may be an inch or more in diameter. The disease may prove fatal from perforation, from hæmorrhage, or from inanition. Its duration is variable, and it is often curable. The treatment should include as much rest as possible for the stomach consistent with nutrition.—Cancer attacks the stomach about as frequently as it does other parts, but it is in this situation nearly always primary; that is, the affection does not make its appearance previously in any other part. The pylorus is the situation mostly attacked, and the disease does not then usually pass into the duodenum. When however the cardiac end of the organ is the seat, the cancer generally also more or less affects the œsophagus. The cancer is generally of the hard variety known as scirrhus. The affection is attended with the peculiar lancinating pains of cancer, and vomiting is frequent, although less so than in simple ulcer. Blood is often found with the vomited matter, generally having the appearance of coffee grounds, and sometimes contains purulent matter. These symptoms are accompanied by progressive anæmia and loss of weight.—Degeneration of the gastric follicles has been found a more frequent affection than was formerly suspected, and is the accompaniment of many

cases of dyspepsia. The treatment should be mainly constitutional, including good air and nutritious diet.—Dilatation of the stomach is usually caused by obstruction of the pylorus, but it sometimes, though rarely, occurs without it. The organ often becomes enormously distended, and filled with undigested and fermented matter, and the muscular coat exceedingly thin. Regulation of the diet is the proper treatment.—The most important functional diseases of the stomach are dyspepsia and gastralgia. (See DYSPEPSIA.) Gastralgia is a painful nervous affection, sometimes of the most excruciating nature. It often accompanies dyspepsia, and sometimes the structural diseases. When existing alone and in an acute form, it may be caused by the presence of obnoxious ingesta. It sometimes results from malaria, frequently accompanies intermittent fever, and is sometimes associated with gout. It rarely attacks old persons or those under the age of puberty. Prof. Alfred Stillé states that it is often produced by chewing tobacco. The remedies during the attack are anodynes. Morphine may be given by the mouth or by hypodermic injection. Bismuth has been used, it is said, with good results, but it is not generally relied on. A few drops of chloroform with water often give speedy relief. The general treatment will depend upon regulating the bodily functions and the diet. When of a malarious origin the preparations of quinia are indicated, in full doses.

**STONE.** See ROCKS.

**STONE**, the common name of calculus in the urinary bladder, for the composition of which see CALCULI and GRAVEL. The prominent symptoms are irritability of the bladder with frequent irresistible desire to pass water, and occasional stoppage of the stream, with pain in various parts of the urinary system, and sometimes the presence of blood, mucus, and pus in the urine. None of these, however, can be depended on, the only sure diagnosis resting on making the stone perceptible to the ear and fingers by means of a metallic sound introduced through the urethra, and brought into direct contact with the foreign body; even with this instrument, several introductions in various positions of the body are sometimes necessary for its detection. The symptoms vary in intensity according to the size and roughness of the stone, the state of the urine, and the condition of the bladder. Stone is formed by a precipitation of the urinary salts either in the kidney, passing thence to the bladder, or primarily in the bladder. In the latter case a foreign body may be the nucleus. Stone may be removed from the bladder by—1, solution; 2, extraction as a whole through the urethra; 3, extraction through an opening artificially made into the bladder (lithotomy); 4, crushing into fragments of such a size that they can pass through the urethra (lithotripsy). 1. Solution may be attempted by remedies taken by the mouth or injected into the bladder. Uric acid calculi have been treated by the administration of alkalies, and the phosphatic by the injection of a solution of nitric acid. These methods have from their inefficacy fallen into disuse. 2. Extraction by the urethra is now done only in females; in them the canal is so short and dilatable that a stone of considerable size can be removed by this method. 3. Lithotomy is indicated in all males under puberty, and in others when the stone is large or there are several; when the urethra is strictured; when the bladder is in such a condition as to be unable to bear the repeated introduction of instruments, and the irritation caused by the fragments resulting from lithotripsy; and when the kidneys are not much diseased. The operation may be done by incision above the pubes (the supra-pubic), through the perineum (the perineal), or through the rectum, or rectum and perineum (the recto-vesical). The supra-pubic and that through the rectum and perineum are usually employed only in cases in which, from the size of the stone or other causes, removal through the perineum is impossible. The perineal operations are three in number, the lateral, bilateral, and median. The lateral operation is in general the best, and it may be performed as follows: A grooved steel staff or sound of full size is introduced, the bladder being moderately distended, the patient on his back, with shoulders elevated, thighs separated widely in order to expose the perineum, and the hand grasping and bound to the foot; the patient being etherized, an incision is made on the left side of the perineum from about an inch before the anus downward and outward to a point midway between the anal opening and the tuberosity of the ischium, the muscular fibres being divided down to the staff; the left index finger passed into the wound keeps back the rectum, and at the same time feels at the membranous part of the urethra the groove, which is entered by the knife and conducts it to the bladder, the urethra and about half an inch of the prostate being divided; the finger is then introduced, dilating the opening; the finger being withdrawn, the forceps are introduced, opened, and the stone seized, if possible, with the first gush of fluid from the wound, and then extracted by slow, steady, and undulating movements, dilating and not tearing the soft parts. If properly performed, and the after treatment not interfered with by hæmorrhage, inflammation, sloughing, or other complications, the urine begins to flow by the urethra in about a week, and the wound heals completely in four or five weeks. In the bilateral operation, a curved incision, with the convexity upward, is made from one side of the perineum to the other, between the anus and the urethral bulb, dividing both sides of the prostate by a double bistoury. The median operation differs from the preceding in that the incision is vertical and in the median line, and the prostate is not cut, but is dilated, and somewhat lacerated, by

the finger introduced through the opening made into the urethra in front. The recto-vesical operation consists in cutting into the bladder from the rectum on the median line behind the prostate, or in dividing also the prostate and perineum in the median line. In the high operation the bladder is opened above the pubes through the linea alba, where there is no covering of peritoneum. Lithotomy was practised 25 centuries ago; Hippocrates bound his pupils by oath not to practise it, but it came into use again in the time of Celsus, in whose writings are found the first indications of the bilateral operation; the lateral operation was first practised toward the end of the 17th century; the supra-pubic method was first employed by Franco in the 16th century, and the recto-vesical by Sanson in the 19th. 4. Lithotripsy (more commonly called lithotrity) is indicated in patients beyond puberty, when the stone is single and not large, and when the urethra is not strictured, and the bladder and kidneys are not much diseased. The early instruments used for this purpose were very rude and dangerous, the stone being grasped by branches made to protrude from a straight catheter, and then bored by a drill extending through the instrument and worked by a watchmaker's bow; after it was bored it was crushed by another complicated instrument. To Civiale (1817–'24) is unquestionably due the credit of having introduced the operation by improving the instruments and the manner of their use. The instrument now used is composed of two sliding blades, introduced in the shape and after the manner of a sound, between which the stone is seized, and then crushed by the gradual pressure of a screw; the fragments may then be washed out by injections or by the urine, large pieces being again broken by the same or a smaller instrument. In properly selected cases, and with skilful manipulation, this operation is much safer than lithotomy.

**STONE.** **I.** A N. county of Arkansas, bounded N. E. by White river, and watered by the Little Red river. It was formed in 1873 from portions of Independence, Izard, Searcy, and Van Buren counties. The surface is irregular. The soil produces cotton, grain, tobacco, and fruits. Timber is abundant. Iron, lead, and marble occur. Capital, Mountain View. **II.** A S. W. county of Missouri, bordering on Arkansas, intersected by White river, and drained by its tributary the James; area, about 500 sq. m.; pop. in 1870, 3,253, of whom 20 were colored. The surface is broken, and the soil fertile. The Atlantic and Pacific railroad touches the N. W. corner. The chief productions in 1870 were 13,022 bushels of wheat, 121,735 of Indian corn, 14,340 of oats, 3,205 lbs. of tobacco, 3,521 of wool, 27,817 of butter, and 3,808 gallons of sorghum molasses. There were 1,298 horses, 905 milch cows, 1,683 other cattle, 3,023 sheep, and 10,722 swine. Capital, Galena. **III.** An E. county of Dakota, recently formed and not included in the census of 1870; area, about 700 sq. m. It is mostly table land, and has a rolling surface.



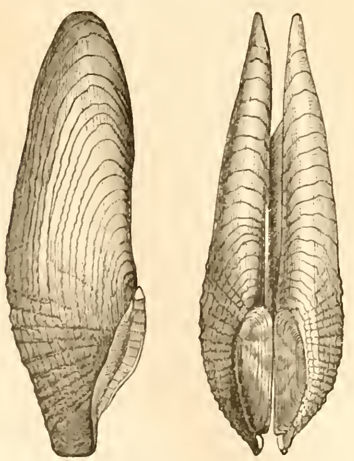
**STONE, Marcus.** See p. 898.

**STONE, Thomas,** a signer of the Declaration of Independence, born at Pointon Manor, Charles co., Md., in 1743, died at Port Tobacco, Md., Oct. 5, 1787. He was a lawyer, and was sent as a delegate to congress in 1774 and 1775. He strongly favored the establishment of an independent government, although under instruction from the Maryland convention to oppose it; but that state receded from its opposition in time to allow its delegates to sign the Declaration. He served on the committee to prepare a plan of confederation, and was reëlected to congress in 1777 and 1783.

**STONE.** **I. William Leete,** an American author, born at New Paltz, N. Y., April 20, 1792, died at Saratoga Springs, Aug. 15, 1844. He was a printer, and edited successively the "Herkimer American," "Hudson Whig," "The Lounger" (Hudson), "Albany Daily Advertiser," "Hartford Mirror," "The Knights of the Round Table" at Hartford, and from 1821 the New York "Commercial Advertiser." In 1843–'4 he was superintendent of common schools in New York. His principal works are: "History of the Great Albany Convention of 1821" (8vo); "Narrative of the Grand Erie Canal Celebration" (New York, 1825); "Letters on Masonry and Anti-Masonry" (1832); "Matthias and his Impostures" (12mo, 1832, and 18mo, 1835); "Tales and Sketches" (2 vols. 12mo, 1834); "Essays on Social and Literary Topics" (12mo, 1835); "Ups and Downs in the Life of a Distressed Gentleman" (12mo, 1836); "Life of Maria Monk and Refutation of the Awful Disclosures" (8vo, 1836); "Letters on Animal Magnetism" (8vo, 1837); "Life of Joseph Brant" (2 vols. 8vo, 1838; new ed. by W. L. Stone, jr., with index, Albany, 1865); "Border Wars of the American Revolution" (2 vols. 12mo, 1839); "Poetry and History of Wyoming" (12mo, 1841; with index, 1864); "Life of Red Jacket—Sa-go-ye-wat-ha" (8vo, 1835 and 1841; new ed. with a life of the author by W. L. Stone, jr., 1866); and "Life of Uncas and Miantonomoh" (24mo, 1842). **II. William Leete,** jr., son of the preceding, born in New York, April 4, 1835. He graduated at Brown university in 1858 and at the Albany law school in 1859, and is now (1876) one of the editors of the "New York School Journal." He has published "Life and Times of Sir William Johnson, Bart.," begun by his father (2 vols. 8vo, 1865); "Life and Writings of Col. William L. Stone" (1866); "Saratoga and its Mineral Springs" (1866); "History of New York City" (1872); "The True History of the Jane McCrea Tragedy" (1874); "Reminiscences of Saratoga" (1874); and "Centennial Sketches" (1876). He has translated from the German the "Memoirs and Letters of Mrs. General Riedesel" (1867), and the "Life and Military Journals of Major General Riedesel" (2 vols. 8vo, 1868).

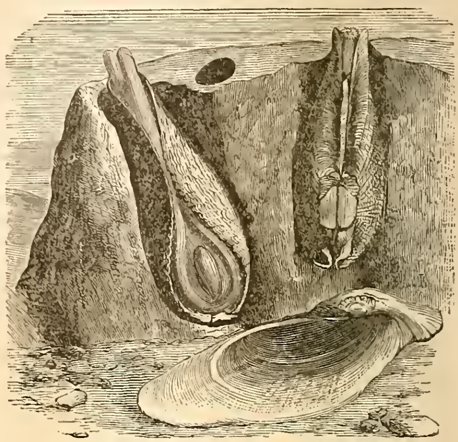
**STONE, William Oliver,** an American painter, born in Derby, Conn., Sept. 26, 1830, died in Newport, R. I., Sept. 15, 1875. He studied under Nathaniel Jocelyn in New Haven, lost all his early pictures by the burning of his studio, and removed to New York in 1851. His first picture exhibited in the national academy was "The Mantilla" (1854), and he afterward painted many portraits of prominent persons, being especially successful in those of women and children. He became a member of the national academy in 1859.

**STONE BORER,** a name given to several bivalve shells, especially *pholas* (Linn.) and *lithodomus* (Cuv.), from their power of boring into the hardest rocks. The *pholadidæ* (Gr. *φωλεύειν*, to hide in a hole) are true bivalves, and have two accessory plates in the neighborhood of the hinge for the protection of the dorsal muscles; they belong to the group *siphonophora* (Gray), or those having long respiratory siphons, united for the greater part of their length; they are all burrowing animals, penetrating the hardest substances. The shells are usually elongated, gaping at one or both ends, and closed by two adductor muscles; the foot is large and powerful, and the mantle is closed; they are found in all climates. The typical genus *pholas* is often of considerable size, with a white, hard, rough, but very brittle shell, rendering it an interesting question how it can perforate a solid rock; the operation is supposed to be performed by a rotatory motion of the shell effected by the powerful foot. The date shell or piddock (*P. dactylus*, Linn.), about 2 in. long and 6 or 7 in. wide, is found along the European coast, mostly in calcareous rocks; it is eaten along the Mediterranean. It is very luminous, and hence some have supposed that its excavations may



Date Shell (Pholas dactylus).

be partly due to electrical action on the sea water. The smaller *P. candida* (Linn.) is used for bait in England. The *P. crispata* (Linn.) is found along the coasts of our middle and southern states. Many fossil species are known. The family of *veneracea*, of the same group, are also stone borers, principally by means of



Stone Borers (Pholas dactylus) which have hollowed out shelters in a block of gneiss.

the foot.—Among the asiphonate bivalves, the most remarkable stone borer is the *lithodomus lithophagus* (Cuv.); it is commonly found in holes which it has excavated in calcareous and coral formations; it is the sea date shell of the Mediterranean, and is a delicate article of food. Its perforations have served as important indications of the change of level of the sea coast in modern times; the columns of the temple of Serapis at Pozzuoli are perforated by these shells at a considerable height above the actual level of the sea.—Another bivalve, coming near the clams, generally considered a stone borer, is *saxicava* (Lam.), which appears under such a variety of forms that two genera and at least 15 species have been made of the single representative, *S. rugosa* (Lam.); the young symmetrical form constitutes the genus *hiatella* (Bosc). It is found in almost all parts of the world, largest in the arctic seas, in crevices of rocks and corals, assuming very exactly the shape of the cavity which contains it; it occurs from low-water mark to the depth of 140 fathoms; it is found fossil in the miocene and glacial deposits. It has been questioned whether *saxicava* is the excavator of the holes in which it is found, and the subject of the mechanism by which the stone borers operate is by no means well understood.—Sea urchins also may in many instances be called stone borers, the excavation of their cavities being effected by the constant action of their spines, and perhaps also by the vibratile cilia of their ambulacral tubes and suckers. It is conceivable, if not probable, that the continual action of soft vibratile cilia may excavate holes even in the hardest rocks.

**STONE CHAT** (*saxicola rubicola*, Bechst.), a dentirostral bird of the warbler family, and

subfamily *erythacinæ*, or old world robins. The bill is short, with broad gape, furnished with bristles; wings long and rounded, with fourth and fifth quills equal and longest; tail short and broad; tarsi and toes slender, and

Stone Chat (Saxicola rubicola).

hind toe long. There are several species. The stone chat, resident in England but migratory on the continent, is about $4\frac{1}{2}$ in. long; the head, throat, and back black, on the latter edged with whitish red; sides of neck, upper part of wings, and rump white; breast orange brown; lower parts reddish white. A similar but migratory species is the whin chat (*S. rubetra*, Bechst.), so named for its partiality for furze or whin bushes. These two species belong to the subgenus *pratincola* (Koch).

**STONE CROP.** See SEDUM.

**STONEHENGE,** a collection of huge stones on Salisbury plain, Wiltshire, England, about 8 m. N. of Salisbury. Its name is old Saxon, and signifies "hanging stones." Seen from a distance, they appear to be merely an irregular

Stonehenge.

mass of stones, but a closer inspection shows them to have been originally arranged to form two ovals within two circles, surrounded by a bank of earth 15 ft. high and 1,010 ft. in circumference. There are altogether about 140 stones, weighing from 10 to 70 tons. They are much weather-worn, but in many of them the sharp angles and the tenons and mortices by which they were joined are well preserved. The outer circle has 17 stones remaining out of 30; the inner has but 8 stones entire, and fragments of 12 others. The inner oval consisted of about 20 smaller stones, of which 11 are still standing; the other oval consisted of 10 stones, of which 8 are remaining. Scattered over the plain are about 300 tumuli, or barrows, some of which have been opened, and found to contain charred human bones, fragments of pottery, and British and Roman ornaments and weapons. In the centre is a flat slab 15 ft. long, which is supposed to have been the altar; it is a grained calcareous sandstone, which strikes fire with steel. On excavating at the foot of this altar, remains of oxen, deer, and other animals were found, intermixed with burnt wood and fragments of Roman and British pottery. According to Geoffrey of Monmouth, Stonehenge was erected by order of Aurelianus Ambrosius, the last British king, in honor of 460 Britons slain by Hengist the Saxon; but Polydore Vergil argues that it was a monument to the memory of that king. Some authorities believe it to have been a druidic temple, others assert that it was an astronomical observatory, and others that it was a place both of worship and of council, which was also used for assemblies of the people. Similar stone circles have been found in various parts of the world, and Sir John Lubbock refers them all to the bronze age, while other antiquaries and geologists maintain that some of them were erected 10,000 to 50,000 years ago. Nothing has as yet been brought forward to establish any of these theories beyond controversy and doubt.

**STONE RIVER, Battle of.** See MURFREESBORO.

**STONINGTON,** a town, borough, and port of entry of New London co., Conn., on Long Island sound, at the S. E. extremity of the state; pop. of the town in 1870, 6,313, of the borough, 1,561. The town is divided into five voting districts, Stonington borough, the villages of Mystic, Mystic Bridge, and Pawcatuck, and the "Road." The borough is built on a narrow rocky point extending about half a mile into the sound, and has a good harbor protected by a breakwater. A second breakwater is now building and a third one is projected. Stonington is a favorite place for summer resort, and has a considerable coasting trade and several vessels employed in sealing. It is connected with Providence by the Stonington and Providence railway, with New London by a branch of the same, and with New York by the New York and Stonington steamboat line. Mystic Bridge is a thriving village, chiefly engaged in ship building. There are in the several villages four banks, a savings bank, 14 churches, 16 public schools, three woollen mills, one cotton mill, a large foundery and machine shop, and several other factories, and a weekly newspaper. On June 30, 1874, its

shipping amounted in the aggregate to 119 vessels of 16,978 aggregate tonnage.—The town was settled in 1649, and the borough was incorporated in 1801. On Aug. 9 and 10, 1814, the borough was attacked by the British fleet under Sir Thomas Hardy, but it was compelled by the volunteers and militia to retire.

**STONY POINT,** a small rocky promontory on the right bank of the Hudson river, in Rockland co., N. Y., 42 m. N. of New York, at the entrance of the Highlands, and opposite Verplanck's Point. On both these points forts were built by the Americans during the revolution, which were captured by Sir Henry Clinton about the first of June, 1779, strengthened, and garrisoned; but that on Stony Point was retaken by a bold night attack under Gen. Anthony Wayne, with 1,200 men, July 16, and the garrison of 543 officers and men made prisoners. The Americans had 15 killed and 83 wounded, and the British 63 killed. The simultaneous attack on Verplanck's Point having failed, the works on Stony Point were destroyed and abandoned on the 18th.

**STOPPAGE IN TRANSITU,** in law, the arresting by the seller of goods on their passage to a distant purchaser who has become insolvent. When and how the doctrine of stoppage in transitu became a part of our law cannot be definitely asserted. Its introduction was comparatively recent. The right exists only between a buyer and a seller. A surety for the price of the goods, bound to pay for them if the buyer does not, has not this right; but one who is substantially a seller has. Thus, one ordered by a foreign correspondent to buy goods for him, and then buying them in his own name and on his own credit, and sending them as ordered, may stop them *in transitu.* So may a principal who sends goods to his factor, or one who remits money for any particular purpose. The reception and negotiation of a bill for the goods does not defeat the right, nor does part payment. But goods cannot be stopped when they are sent to pay a precedent and existing debt.—The right arises only upon actual insolvency, which need not be legal or formal bankruptcy or insolvency. It is enough if the buyer cannot pay his debts, and also that he refuses to comply with the specially agreed terms of the sale, for this is insolvency so far as the seller is concerned. When the goods are stopped, the buyer may, by payment of the price or by tender of security if they were sold on credit, defeat the stoppage and reclaim the goods. If the seller stop the goods maliciously, and without actual belief of the insolvency on good grounds, he would doubtless be answerable for any damages which the buyer might sustain. The seller's right to stop the goods cannot be defeated by any sale or mortgage thereof by the buyer, or by any claim or lien or attachment of any other person, except such lien as may arise in favor of any carrier by whom they have been conveyed.—Nice questions have arisen in respect to the *transitus.* Generally speaking, the goods are in transit when they are not in the actual possession either of the buyer or of the seller. But the law goes sometimes further than this, and inquires into the constructive possession; for the goods may be in the actual possession of the seller, and yet so far constructively in the possession of the buyer that the seller cannot retain them; or they may be in the actual possession of the buyer, but under such circumstances that the seller's right is not taken away. It becomes, therefore, very important in many instances to ascertain whether the transit is complete. A carrier of goods, by land as well as by sea, acquires a lien on the goods which he carries for the freight money. The goods are still in transit, and may be stopped, so long as the carrier withholds them from the buyer by his lien for the freight, and a seller who seeks to stop them then must discharge this lien. In general, whenever a carrier enters into a new arrangement with the consignee, by which he agrees to hold the goods as the property of the consignee and at his disposal, there is a termination of the transit. Yet all acts in reference to such question must be open to explanation by existing circumstances, the general inquiry in such case being whether the carrier, warehouseman, wharfinger, or other person having actual possession of the goods at the time of the intended stoppage in transitu, was then acting as the agent of the seller or of the buyer; for if of the latter, the transit was terminated. If the buyer order the goods to be sent to some other person by any suitable conveyance without designating any one especially, or by a designated carrier who is not specifically his agent or servant, the goods remain in transitu until they reach that second person. Questions of constructive possession arise very frequently in respect to goods in the charge of warehousemen. In general, every warehouseman is the agent of any party who puts the goods in his warehouse and can take them out at his pleasure; and therefore his possession is the possession of such party. On this point it is a material question whether anything remains to be done by the seller; if nothing, this goes far to make the warehousing a delivery to the buyer. If a seller of goods that are warehoused delivers an order for them to a buyer, this alone may not transfer the possession; but if the buyer delivers the order to the warehouseman, this in general transfers the possession, and still more so if the warehouseman enters the same in his books or otherwise accepts the order, so as to be responsible for the goods to the buyer. If the buyer sells to a third party, to whom the warehouseman certifies that the goods are transferred to his account, and who thereupon pays the price, the warehouseman becomes responsible to this third party; and if the original seller, though there remained something material to be done by him to the goods, consented to the warehouseman's so certifying, he would be held to

have lost his right of stoppage in transitu.—The effect of the bill of lading upon the right of a seller to stop the goods in transitu is very important. The law regards the bill of lading, not as a mere receipt which the carrier gives for the goods, but rather as a muniment of title, carrying property with it, and being itself *quasi* negotiable. An indorsement and delivery of the bill for value operate as a symbolic delivery of the goods mentioned in it. It results from this doctrine that a consignee, who sells for value goods to arrive and indorses over the bill of lading, confers upon the purchaser a title and property which destroy the right of the seller of the goods to stop them *in transitu.* But if the party buying from the consignee knows that the sale is in fraud of the original seller, it is voidable by that seller of course; and if he knows that the consignee is, or is about to become, insolvent, this knowledge would probably have the same effect, as would also knowledge or notice of any circumstances which rendered the bill of lading not properly assignable. If the bill of lading be transferred and indorsed by way of pledge to secure the consignee's debt, the consignor does not lose entirely his right to stop the goods, but holds it subject to the rights of the pledgee; that is, he may enforce his claim to hold the surplus of the goods after the pledgee's claim is satisfied, and he holds this surplus to secure the debt of the consignee to him.—The insolvency of the buyer, however complete or however manifested, will not operate of itself as a stoppage in transitu. The goods must be actually stopped, in some way which the law recognizes as adequate, by the seller or his authorized agent. An actual taking possession by the seller is not necessary, at least not in all cases, although actual possession should be taken if possible, and as soon as possible. A constructive possession may be acquired by giving notice to the carrier or warehouseman, forbidding him to deliver the goods to the buyer, and requiring him to give them up to the seller or his agent, or to hold them subject to his order. Delivery in disregard of this notice does not defeat the seller's right; he has still a constructive possession, and the carrier is responsible to him for all the injury he may sustain. Or, if the buyer becomes insolvent, and the goods pass into the possession of his assignees, the seller may maintain an action of trover against them. What the consignor may do personally, he may do by his agent; and if the demand be made by one who acts as agent, but without authority, a subsequent adoption and ratification will have the effect of a previous authority, provided this be made before the goods are demanded by the buyer.

**STORAX.** See Balsams.

**STOREY,** a W. county of Nevada, bounded N. by Truckee river and S. by the Carson; area, 420 sq. m.; pop. in 1875, 19,528, of whom 1,341 were Chinese. The valleys of the rivers contain small tracts of arable land, but the county derives its importance from the Comstock lode, on Mt. Davidson (7,000 ft. high), the richest silver-bearing lode in the world. In 1870 there were 19 quartz mines, producing gold and silver to the value of $7,751,331; but the production has since very greatly increased. There were 3 manufactories of boots and shoes, 3 of carriages and wagons, 5 of furniture, 3 of iron castings, 3 of jewelry, 4 of machinery, 3 of saddlery, 4 of tin ware, 8 breweries, and 26 quartz mills. Capital, Virginia City.

**STOREY, George Adolphus.** See p. 899.

**STORK,** a wading bird of the heron family, subfamily *ciconinæ*, and genus *ciconia* (Linn.); other allied genera are the jabiru and marabou, described under their own names. In the storks the bill is long, straight, strong, gradually tapering to a sharp tip; sides compressed; wings long and ample, the third and fourth quills the longest and equal; tail short and broad; tarsi long and scaled; toes short and stout, webbed to the first joint; hind toe elevated, partly resting on the ground. They are large, most abundant in warm countries, and performing periodical migrations to and from the marshy regions of Europe, Asia, and Africa; like vultures and other carrion feeders, they eat almost any kind of garbage that comes in their way, and are hence valuable scavengers in hot climates; they seek their food on the borders of streams; the body is light and well balanced; during flight the head is thrown back and the legs are extended; the space round the orbits is destitute of feathers, and in some the whole face and throat are naked. There are about a dozen species, of which the best known is the white stork (*C. alba*, Briss.);

White Stork (Ciconia alba).

it is 3½ ft. long, the bill 7¾ in.; the general color is white, with the quills and wing coverts black, and bill and feet red; around the eyes a bald blackish circle; it is the *cigogne* of the French. They arrive in N. Europe, especially in Holland and Germany, in the spring, return-

ing in the autumn to Africa by night and in large flocks; the only noise they make is by clapping the mandibles together like a pair of castanets; they rest sleeping on one leg, with the neck folded and head turned backward on the shoulder. The food consists of reptiles, fish, young birds, and insects. The nest is large, coarsely made of sticks and twigs, placed on housetops (often in the midst of crowded cities), and is repaired by the males year after year; the eggs are three or four, white tinged with buff, $2\frac{5}{6}$ by 2 in.; both sexes incubate, and the young are hatched in about a month; the nestlings are tenderly cared for, and are fed by food regurgitated from the parents' stomachs. The flight is very high, and the gait slow, with long and measured steps; the disposition is gentle, the manner familiar, and the docility considerable; they do not propagate in captivity. The stork was considered by the ancients as the personification of piety, conjugal and filial love, gratitude, and temperance; it was supposed to bear a charmed life, and it was a crime to offer it violence; in some places it was even an object of worship, and in hieroglyphic language it is the symbol of piety and beneficence; "pious" or "beneficent" is also the meaning of its name in Hebrew (*'hasidah*). The black stork (*C. nigra*, Bechst.) is about $2\frac{3}{4}$ ft. long, with a bill of $5\frac{1}{2}$ in.; the color above is black with green and purplish gloss, and white below. It avoids the vicinity of man, nests in trees, and feeds like the herons chiefly on fish; it is found in many countries of Europe, especially in the Alps. The American stork (*C. Americana*, Briss.) is about as large as the white species; it is found in South America, particularly in Brazil.

**STORMONT,** an E. county of Ontario, Canada, bounded S. E. by the St. Lawrence river; area, 409 sq. m.; pop. in 1871, 18,987, of whom 6,229 were of Scotch, 4,191 of Irish, 3,125 of German, 2,233 of French, 1,621 of English, and 1,322 of Dutch origin or descent. It is watered by several small streams, and is traversed by the Grand Trunk railway. Capital, Cornwall.

**STORMS,** violent atmospheric disturbances. (See WIND.) Storm areas are in general characterized by low barometric pressure at their centres; winds increasing in force toward the central region, and by their directions showing the lower portion of the atmosphere to be moving spirally in, toward and around the centre; heavy masses of low clouds attended by a higher stratum that moves around and out from the centre; rain or snow falling especially on the advancing side or front of the storm; temperatures above the average in front, and below the average in the rear of the storm. The storm area with its attending features moves bodily along the earth's surface for several days. A map showing the average number of centres of storms that pass over the eastern portions of the United States is published in the "Statistical Atlas" of the census bureau (1875), and is here reproduced. The number of storm centres passing over any region increases as we go from the lower latitudes toward Hudson bay, being greatest in the region of the St. Lawrence valley and the great lakes. This arises from the fact that while on the one hand many storms move eastward along the northern limits of our field of observation, on the other hand the storms that originate in the lower latitudes tend to move northward. Nine tenths of the storm tracks on which this map is based have moved toward and over New England and Lower Canada. The chart also shows in Nebraska a region of specially numerous storm tracks, from the fact that the storms coming both from Texas and from Dakota frequently move respectively N. E. and S. E. toward this region; and frequently we find here also the first trace of a class of storms that appear to originate on the spot. The peculiarities in the distribution of storms are apparently fully explained by the topography of the continent. When we consider that at any station in the northern hemisphere the winds veer from S. E. to S. W. and N. W. as a storm centre passes N. of it, we perceive from this map that throughout the United States E. of the Rocky mountains the veering of the wind will be more frequent than its backing, in the proportions indicated by the relative number of storm centres that pass to the north and south of the station. For the ocean, it has in general not yet been possible to compile any general map of the average paths of the storms; but from the logs of vessels a great mass of information relative to the frequency of gales and stormy winds has been compiled, and this information is very nearly related to that given by the accompanying chart. The first map of this kind was compiled at the United States naval observatory by M. F. Maury; and the work of collecting such data has been actively pursued by the meteorological officers of all nations, especially England and Holland.—Within 20° of the equator storm winds are exceedingly rare, but their number increases rapidly as we approach the latitude of 50° N. or S. During our northern summer the percentage of storminess diminishes in the North Atlantic and increases in the South Atlantic ocean. In either hemisphere, winter is its stormy season. Within the limits of our observations, viz., up to the parallel of 40° on either side of the equator and in mid-ocean, the southern winter is sensibly as stormy as the northern; but beyond these parallels, and especially near the coast of North and South America, the northern hemisphere is far more stormy than the southern; the probable cause is the greater mass of dry land, and consequently of dry cold air, contiguous to the North Atlantic, as compared with the little land bordering the South Atlantic. Among the regions most frequently passed over by vessels of all nations, the neighborhoods of Cape Horn and the cape of Good Hope are next in importance to the great


From 1 to 5
From 5 to 10
From 10 to 15
From 15 to 20
From 20 to 22.5
From 10 to 15
From 15 to 20
From 5 to 10
From 10 to 15
From 15 to 20
From 5 to 10
BRITISH POSSESSIONS
PROVINCE OF ONTARIO
PROVINCE OF QUEBEC
N.BRUNSWICK
MAINE
VERMONT
N.HAMPSHIRE
MASS.
CONN.
NEW YORK
PENNSYLVANIA
OHIO
INDIANA
ILLINOIS
MICHIGAN
WISCONSIN
MINNESOTA
IOWA
DAKOTA
NEBRASKA
KANSAS
MISSOURI
KENTUCKY
WEST VIRGINIA
VIRGINIA
NORTH CAROLINA
TENNESSEE
INDIAN TERRITORY
LAKE SUPERIOR
LAKE MICHIGAN
LAKE HURON
LAKE ERIE
L. ONTARIO
Pembina
Ft. Abercrombie
Ft. Randall
Yankton
Sioux City
Omaha
Lincoln
Ft. Kearney
Nebraska City
Des Moines
Iowa City
Dubuque
Clinton
Davenport
Burlington
Keokuk
Atchison
Leavenworth
Ft. Riley
Topeka
Lawrence
Ft. Scott
Kansas City
Jefferson City
St. Joseph
Hannibal
Quincy
Springfield
ST. LOUIS
Cairo
Columbus
Springfield
Ft. Gibson
Ft. Smith
Little Rock
Memphis
Superior
St. Paul
La Crosse
Madison
Prairie du Chien
Milwaukee
CHICAGO
Green Bay
Escanaba
Marquette
Mackinac
Grand Haven
Lansing
Detroit
Toledo
Cleveland
Erie
Indianapolis
CINCINNATI
Columbus
Wheeling
Pittsburgh
Vincennes
Louisville
Frankfort
Bowling Green
Nashville
Knoxville
Chattanooga
Decatur
Toronto
Buffalo
Rochester
Oswego
Salamanca
Elmira
Williamsport
Albany
Troy
Ottawa
Montreal
Quebec
Montpelier
Concord
Augusta
Portland
Eastport
BOSTON
Providence
Hartford
NEW YORK
Trenton
PHILADELPHIA
Wilmington
Harrisburg
BALTIMORE
WASHINGTON
Richmond
Norfolk
Lynchburg
Danville
Greensboro
Raleigh
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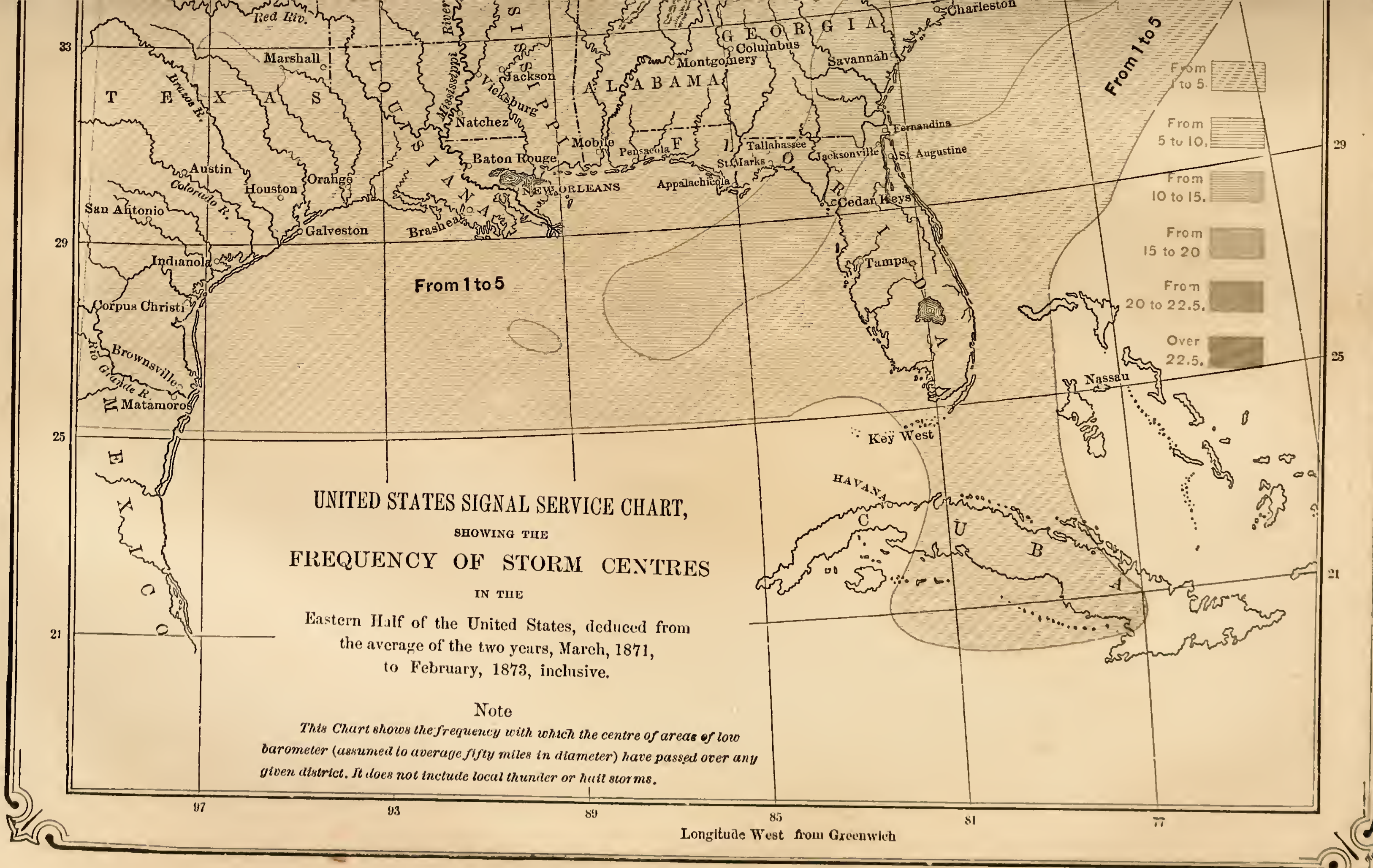


UNITED STATES SIGNAL SERVICE CHART,

SHOWING THE

FREQUENCY OF STORM CENTRES

IN THE

Eastern Half of the United States, deduced from the average of the two years, March, 1871, to February, 1873, inclusive.

Note

*This Chart shows the frequency with which the centre of areas of low barometer (assumed to average fifty miles in diameter) have passed over any given district. It does not include local thunder or hail storms.*


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highway between Europe and America. The charts of the ocean in the neighborhood of Cape Horn, published by the London meteorological office (1871), do not give the percentages of storms; but for the cape of Good Hope, the charts of Cornelissen (1874), of the meteorological institute of the Netherlands, show that during the southern summer the storms in this region are comparatively few and feeble. In winter severe westerly gales are exceedingly abundant to the south of the cape. In the immediate neighborhood of the continent, and on either side, the influence of the land is shown in the frequency of storm winds blowing off shore during winter, and on shore during summer.—*Storm Warnings.* Suggestions for storm warnings were broached even in the 18th century, before the introduction of the electric telegraph had rendered the undertaking practicable. The Europeans were the first to engage systematically in storm warning; but in the early demonstration of the feasibility of the idea, the merchants and the individual meteorologists of the United States took the lead. If we pass by that which Franklin, Espy, Bache, Redfield, Loomis, Maury, and others did to advance our knowledge of atmospheric phenomena, and consider merely the steps taken to establish national systems of storm warnings, we shall note that in 1835 the joint meteorological committee of the Franklin institute and the American philosophical society at Philadelphia appointed, at the suggestion of Bache and Espy, a sub-committee to memorialize congress upon the subject of a national weather bureau for the study and prediction of storms. When the success of the Morse telegraph was beyond all question, Redfield in 1846, and Loomis in 1847, urged its systematic application to the problem in hand. This idea was greatly furthered by Prof. Joseph Henry, who as secretary of the Smithsonian institution had just removed to Washington. In 1847, in behalf of that institution, he organized a system of volunteer meteorological observations and reports. Through the liberality of the National telegraph line, Prof. Henry was in 1857 able to begin the publication of a telegraphic weather bulletin, and to make successful weather predictions. Meanwhile, the appointment of Espy as meteorologist successively to the war and navy departments, and the publication (1850 and 1857) of his famous reports on meteorology, had awakened a universal conviction that storm predictions were practicable. Already many merchants were habitually obtaining at their own expense weather reports from distant sections. The Smithsonian weather bulletin was of necessity discontinued in 1861, and an effort to revive it in 1864 was frustrated only by a conflagration which destroyed a portion of the Smithsonian building early in the following year. It does not appear that anything more was done in America in the prosecution of the subject of weather predictions until in 1868, in his inaugural report as director of the Cincinnati observatory, the writer proposed this as a work proper for one branch of the institution which he proposed to build up in that city. A few months after this date the Cincinnati chamber of commerce authorized him to obtain at its expense, for three months, the necessary telegrams, and to publish daily weather predictions. This system went into operation on Sept. 1, 1869. In a modified form, and pending further negotiations, the work was continued at the joint expense of the writer and the Western Union telegraph company from December, 1869, to May, 1870, and afterward entirely at the expense of that company, whose manifold weather maps were in much demand until the commencement in November, 1870, of the great work of the army signal office. (See Signal Service.)—Simultaneously with the spread of the telegraph in Europe began the publication of weather bulletins, and their collation and study. Kämtz says that even in 1835 he had begun to study the weather reports in the Berlin papers, but it required the excitement of the Crimean war, in 1854, to force the importance of the subject upon the attention of European governments. In that year Leverrier as director of the Paris observatory took up the subject; his telegraphic reports began in 1855, and his international bulletin in 1858. Weather probabilities were not begun till 1863; these were discontinued in 1865, and only lately have been revived, but storm warning signals have been uninterruptedly displayed since 1860. In 1861 Admiral Fitzroy, of the meteorological department of the board of trade, began the display of storm signals in England, and in the latter part of the year the publication of weather forecasts; his system of warnings consisted rather of a series of signals announcing the presence of storms, than of any real prediction of their advent. The Fitzroy system ceased in 1866, shortly after his death, but was renewed in 1867. Since that time the British ports have regularly received storm warnings, but the display of the storm signal and storm drum was only revived in March, 1875. The French and English systems of storm warnings were in some respects preceded by the system organized in Holland by Buys-Ballot, who in 1854 had announced his famous rule for that country in regard to the direction of the wind, as depending on barometric disturbance. In 1860 he began the communication to the shipping ports of storm warning despatches, and was in fact by his signals the first to utilize the despatches contained in the telegraphic weather bulletins of Leverrier. The organization of the French, English, and Dutch systems suffices to furnish for other European nations such storm predictions as are needed for their respective ports. Thus Spain, Italy, Sweden, Hanover, Russia, Austria, and Turkey receive regularly from Paris and London announcements of the condition of the weath-

er, especially of impending storms. Every nation of the civilized world, including China and Japan, now has national offices for collecting and utilizing meteorological observations. As a general rule, the warning signal, whether it be the drum or cone as in England, or the flags and lights adopted in other countries, is intended to announce merely that the chances are that there will soon be a dangerous high wind in the neighborhood of the station.

**STORRS, Richard Salter**, an American clergyman, born in Braintree, Mass., Aug. 21, 1821. He graduated at Amherst college in 1839, and at Andover theological seminary in 1845, and was ordained pastor of the Harvard Congregational church, Brookline, Mass. In 1846 he became pastor of the church of the Pilgrims, Brooklyn, N. Y., which post he still retains (1876). He was associate editor of the "Independent" newspaper from its commencement in 1848 to 1861. He has published a report on the revision of the English version of the Bible undertaken by the American Bible society; "Graham Lectures, on the Wisdom, Power, and Goodness of God, as manifested in the Constitution of the Human Soul" (New York, 1856); and lectures on "The Conditions of Success in Preaching without Notes" (1875).

**STORY**, a central county of Iowa, intersected by Skunk river; area, 550 sq. m.; pop. in 1870, 11,651. The surface is undulating and the soil fertile. The chief productions in 1870 were 131,022 bushels of wheat, 390,395 of Indian corn, 97,938 of oats, 25,066 of potatoes, 13,730 tons of hay, 8,918 lbs. of wool, 132,249 of butter, and 5,751 gallons of sorghum molasses. There were 1,580 horses, 2,253 milch cows, 4,021 other cattle, 3,185 sheep, and 5,388 swine. The Chicago and Northwestern railroad passes through the capital, Nevada.

**STORY. I. Joseph**, an American jurist, born in Marblehead, Mass., Sept. 18, 1779, died in Cambridge, Sept. 10, 1845. He graduated at Harvard college in 1798, and studied law in Marblehead. In 1801 he removed to Salem and was admitted to the bar. He soon acquired a lucrative practice and the warm friendship of some of the leading federalists, though he was a republican. In 1804 he published a volume of poems containing "The Power of Solitude" and some smaller pieces, but it was not successful. From 1805 to 1808 he was a member of the lower house of the legislature of Massachusetts, and took a very active part as the principal leader on the republican side; but in two of the measures which he espoused, he acted upon purely independent grounds. The first was a bill to increase, and to establish on a permanent basis, the salaries of the justices of the supreme judicial court, which was passed by his exertions in 1807. The other was a bill (1808) to establish a court of chancery for the state; but this did not succeed. In the same year he defended the embargo as the only measure which the administration of Jefferson could have adopted, short of a declaration of war, without submitting to the ignominious restrictions on American commerce by the belligerent powers. He had written in 1806 the celebrated "Memorial of the Inhabitants of Salem relative to the Infringements on the Neutral Trade of the United States," addressed to the president and to congress. In the autumn of 1808 he was elected to congress from the Essex district. In opposition to the administration he exerted himself to procure a repeal of the embargo, upon the ground that he had originally supported it as a temporary measure, and that it had accomplished its real purpose. He left congress before the repeal was consummated, but not before he had largely contributed to bring it about, and Jefferson attributed the repeal almost wholly to his exertions. Declining a reëlection to congress, he was again chosen to a seat in the state legislature in 1810, and in January, 1811, he was elected speaker of the house. On Nov. 18, 1811, he received the appointment of associate justice of the supreme court of the United States; and on Jan. 17, 1812, he resigned the office of speaker. In 1820 he was a member of the convention for the revision of the state constitution. His principal services in that body related to the tenure and the compensation of the judiciary, the apportionment of the house of representatives, and the property basis of the senate. The original constitution contained a clause authorizing the legislature to increase the salaries of the judges of the supreme judicial court. A motion was made and suddenly carried to insert the words "or diminish." The reconsideration and rejection of this amendment were produced by a powerful and brilliant argument by Judge Story, which commanded the assent of more than two thirds of the convention. In 1829 Judge Story was appointed professor of law in Harvard university, on a foundation established by Nathan Dane, for the delivery of lectures on the law of nature, the law of nations, commercial and maritime law, federal law, and federal equity; and for the rest of his life he resided in Cambridge. The law school of which he now became the head immediately attracted students from all parts of the United States. In his constitutional views he was of the school of Washington and Marshall, upholding what he considered as the just powers of the Union, without encroaching upon the rights of the states. His works comprehend "Commentaries on the Constitution of the United States" (3 vols. 8vo, 1833); "Commentaries on the Conflict of Laws" (1834); "Commentaries on Equity Jurisprudence" (2 vols. 8vo, 1836) and "Equity Pleadings" (1838); and treatises on the law of bailments, agency, partnership, bills of exchange, and promissory notes. All of these works have passed through many editions. Judge Story was gifted with great colloquial powers, and his social qualities in private life largely added to the influence of

his learning, talents, and public positions. A life of him by his son, William W. Story, was published at Boston in 1851 (2 vols. 8vo). There is also a collection of his "Miscellaneous Writings" (8vo, 1852). His decisions as a circuit court judge are contained in 13 vols. 8vo, being the reports of Gallison, Mason, Sumner, and Story. His judgments in the supreme court of the United States may be found in the reports of Cranch, Wheaton, Peters, and Howard, from 1811 to 1845. **II. William Wetmore,** an American sculptor and author, son of the preceding, born in Salem, Feb. 12, 1819. He graduated at Harvard college in 1838, and was admitted to the bar in Boston. In 1844 he published a "Treatise on the Law of Contracts," and in 1847 a "Treatise on the Law of Sales of Personal Property." He also published three volumes of "Reports of Cases argued and determined in the Circuit Court of the United States for the First Circuit" (1847). In 1847 he published a small volume of poems; in 1851 a life of his father (2 vols. 8vo); and in 1856 a second volume of poems. Among his subsequent publications are: "Roba di Roma, or Walks and Talks about Rome" (2 vols., London, 1862; New York, 1864; new ed., 1875); "Proportions of the Human Figure" (1866); "Graffiti d'Italia" (Edinburgh, 1869); "A Roman Lawyer in Jerusalem" (1870); and "Nero, an Historical Play" (1875). Since 1848 Mr. Story has resided in Rome, devoting himself to sculpture, for which he early showed a strong inclination. Among his works are a sitting statue of his father, in marble, in the chapel at Mt. Auburn; statues of George Peabody, Josiah Quincy, and Edward Everett; busts of James Russell Lowell and Theodore Parker; and many ideal works of great merit, among which are a "Shepherd Boy," "Little Red Riding-Hood," "Sappho," "Cleopatra," "Jerusalem" (an allegorical female figure representing the desolation of the city after the destruction of the temple), a "Sibyl," and "Semiramis." The last is owned in New York.

**STOTHARD, Thomas,** an English painter, born in London, Aug. 17, 1755, died there, April 27, 1834. At the age of 14 he was apprenticed to a designer of patterns, then became a designer for illustrated books, and studied painting at the royal academy, of which he was elected a member in 1794 and librarian in 1812. He is known by his contributions to "Boydell's Shakespeare," his "Canterbury Pilgrims," the "Flitch of Bacon," the Wellington shield, and his illustrations of Rogers's "Poems" and "Italy." The number of his designs is estimated at 5,000, of which 3,000 have been engraved.—His son Charles Alfred (1786–1821), draughtsman to the society of antiquaries, published a work on the "Monumental Effigies of Great Britain" (13 parts, fol., 1811–'23), in which he was assisted by his wife, afterward Mrs. Bray, and his brother-in-law A. G. Kempe. The former wrote his life and that of his father. (See Bray, Anna Eliza.)

**STOVE.** See Warming and Ventilation.

**STOW, Baron,** an American clergyman, born in Croydon, N. H., June 16, 1801, died in Boston, Dec. 27, 1869. He graduated at Columbian college, D. C., in 1825, and in 1825–'27 edited the "Columbian Star." On Oct. 24, 1827, he was ordained pastor of a Baptist church in Portsmouth, N. H., and in 1832 became pastor of the Baldwin place Baptist church in Boston, and in 1848 of the Rowe street church. He was recording secretary of the board of the general missionary convention from 1838 to 1846. He published "Memoir of Harriet Dow" (1832); "History of the English Baptist Mission to India" (1835); "History of the Danish Mission on the Coast of Coromandel" (1837); "Daily Manna for Christian Pilgrims" (1842); "The Whole Family in Heaven and Earth" (1845); "Question Book of Christian Doctrine" (1848); "The Psalmist," with the Rev. S. F. Smith (1849); "Christian Brotherhood" (1859); and "First Things, or Development of Church Life" (1859). His life has been written by R. H. Neale (Boston, 1870).

**STOW, John,** an English antiquary, born in London in 1525, died April 5, 1605. He was bred a tailor, but from 1560 devoted himself to the study of the antiquities of English history. He made an extensive collection of papers, many of them Catholic records, which occasioned suspicion, and he was cited before an ecclesiastical commission on charges preferred by his own brother, but was acquitted. His works are: a "Summarie of Englysh Chronicles" (12mo, 1561); "Annales, or a Generall Chronicle of England" (4to, 1580); "A Survey of London" (4to, 1598; continued by John Strype, 2 vols., 1720; new eds., 1842 and 1846); and "The Successions of the History of England, from the Beginning of Edward VI. to the End of the Reign of Queen Elizabeth" (1638).

**STOWE. I. Calvin Ellis,** an American clergyman, born at Natick, Mass., April 6, 1802. He graduated at Bowdoin college in 1824, and at Andover theological seminary in 1828, and in 1828–'30 was assistant professor at Andover. In 1830 he became professor of languages in Dartmouth college, and in 1833 of Biblical literature in Lane theological seminary, Cincinnati. In May, 1836, he visited Europe to examine, in behalf of the state of Ohio, the public school system of the German states, and published "Elementary Education in Europe," which was distributed in every district of Ohio by the legislature. He also published reports on the "Education of Immigrants," on "The Course of Instruction in the Primary Schools of Prussia," and on "Elementary Instruction in Prussia." In 1850 he became divinity professor at Bowdoin college, and in 1852 professor of sacred literature in Andover theological seminary. He resigned this office in 1864, and has since resided in Hartford, Conn. His remaining works are: a "History of the Hebrew Commonwealth," translated from the German of Jahn (Andover, 1828; 2

vols., London, 1829); "Lectures on the Sacred Poetry of the Hebrews," from the *Prælectiones* of Lowth, with notes (Andover, 1829); "Introduction to the Criticism and Interpretation of the Bible" (vol. i. only published, Cincinnati, 1835); and "Origin and History of the Books of the Bible" (part i., the New Testament, Hartford, 1867). **II. Harriet Elizabeth Beecher,** wife of the preceding. See BEECHER.

**STOWELL, William Scott,** baron, an English jurist, born in Heworth, Durham, Oct. 17, 1745, died Jan. 28, 1836. He graduated at Oxford in 1764, and was elected a fellow, and soon after a college tutor. In 1774 he became Camden professor of ancient history in the university. In 1779 he was admitted at doctors' commons into the faculty of advocates, and in 1780 was called to the bar. He made a specialty of ecclesiastical and admiralty practice, and within a few years was appointed successively registrar of the court of faculties, judge of the consistory court, vicar general of the archbishop of Canterbury, and advocate general. In 1798 he was made judge of the high court of admiralty, which office he occupied for 30 years. He was elected a member of parliament for Downton in 1790, and was one of the members for the university of Oxford from 1801 to 1821, when he was made a peer. He was a brother of Lord Eldon.

**STRABISMUS.** See SQUINTING.

**STRABO,** a Greek geographer, born at Amasia, in Pontus, Asia Minor, about 54 B. C., died about A. D. 24. He studied rhetoric under Aristodemus at Nysa in Caria; was a pupil at Amisus in Pontus of Tyrannio the grammarian, and at Seleucia in Cilicia of Xenarchus, a peripatetic philosopher. At Alexandria he studied under Boëthus of Sidon, also a peripatetic; and at Tarsus under Athenodorus, a stoic. He travelled in Syria, Egypt, Crete, Greece, and Italy. He wrote "Historical Memoirs," which are lost, and a "Geography." This work, which embodies all the geographical knowledge of the age, is divided into 17 books; the first 2 treat of cosmography, or the description of the earth in general, and the other 15 give accounts of particular countries. Fragments of the 8th and 9th books were discovered in 1875. Among the best editions are those of Casaubon (1597), Kramer (1844–'52), and Meineke (3 vols., 1852; new ed., 1864). There is an English translation by Falconer and Hamilton (3 vols., 1854–'7). (See GEOGRAPHY.)

**STRADELLA, Alessandro,** an Italian musician, born in Naples about 1645, assassinated in Genoa in 1678. He was a singer, violinist, and composer. At Venice he was employed to teach Hortensia, a noble Roman lady of great beauty, with whom a Venetian nobleman was in love. Stradella and Hortensia fell in love and eloped to Rome. Assassins hired by the Venetian found them there, but were so moved by Stradella's music and singing at the church of St. John Lateran, where he was directing the performance of his oratorio "St. John the Baptist," that they informed him of their purpose, and that they had abandoned it. Stradella and Hortensia fled to Turin, where they were favorably received by the duchess regent, and were married. The Venetian hired other assassins, who finally succeeded in wounding Stradella, but he recovered. The next year he and his wife went to Genoa to arrange for the performance of an opera which he had composed at the request of the city. Here other assassins rushed into their chamber and murdered them both. His principal works are the *Oratorio di San Giovanni Battista* and *La forza dell' amor paterno, opera seria* (Genoa, 1678).

**STRADIVARI,** or **Stradivarius, Antonio,** an Italian violin maker, born in Cremona in 1644, died there, Dec. 17, 1737. He was a pupil of Nicolò Amati, and his first violins, made when he was 23 years old, as well as those which he made during the succeeding 20 years, were, in form and style, reproductions of the works of that master. As early as 1668 he began to use a label with his own name, as follows: "Antonius Stradiuarius Cremonensis faciebat, A. D. 16—." For many years the form of his instruments varied; but about 1686 he acquired his peculiar style, which is very manifest in all his subsequent works; although he had three manners and three periods, during one of which, the middle, he produced what is known as the "long" pattern. His productions consist mostly of violins, violas, and violoncellos, though he also made some viols of six and seven strings, as well as mandolins, guitars, and lutes. His instruments are distinguished alike by their external beauty and the superiority of their tone. He was the first to finish his instruments neatly on the inside. He generally selected and cut his wood with great care, and studied the proportions of thickness and breadth most conducive to sonority, the form of the outside line and of the sound holes (in which he attained great elegance), and the lustre and durability of his varnish, and thus produced works that no subsequent maker has been able to rival. So precious are these instruments in the estimation of connoisseurs that the possessors of the finest of them are well known. One, carefully preserved under glass, has never been touched by the bow, and is known as *la pucelle.* The "Dolphin," so called from the richness and variety of the veined wood of its back, formerly belonged to the marquis de la Rosa. The fineness of the wood and the perfection of its form render it the most beautiful work extant of this maker. Others of his famous violins were owned by the late grand duke of Tuscany, M. Allard, Viotti, Artot, and Count Cepol. Several were in the collections of Mr. Goding and Mr. Joseph Gillott in England. Superior specimens command in the market prices ranging from $1,000 to $3,000.

**STRAFFORD,** a S. E. county of New Hampshire, bordering on Maine; area, about 675 sq.

m.; pop. in 1870, 30,243. It has an uneven surface, watered by numerous streams. The soil of the valleys is fertile. Several railroads traverse it. The chief productions in 1870 were 5,122 bushels of wheat, 59,761 of Indian corn, 13,938 of oats, 13,531 of barley, 248,681 of potatoes, 15,752 lbs. of wool, 302,149 of butter, 42,667 of cheese, and 28,903 tons of hay. There were 1,983 horses, 4,227 milch cows, 2,602 working oxen, 3,666 other cattle, 4,627 sheep, and 1,775 swine; 21 manufactories of boots and shoes, 4 of cotton goods, 2 of iron ware, 5 of cotton and woollen machinery, 1 of floor oil cloths, 1 of paper, 1 of sand and emery paper and cloth, 7 of woollen goods, 2 cloth-printing establishments, 2 planing mills, 15 saw mills, 1 flour mill, 3 tanneries, and 1 currying establishment. Capital, Dover.

**STRAFFORD, Thomas Wentworth,** earl of, an English statesman, born in London, April 13, 1593, executed on Tower hill, May 12, 1641. He was educated at Cambridge, travelled abroad, at the age of 21 inherited large family estates, and in 1614 was elected to parliament for the county of York. He was at first a leading member of the opposition, but in 1628 he was created by Charles I. Baron and Viscount Wentworth, joined the court party, and soon became the king's most trusted counsellor. He was appointed lord president of the council of the north, and in 1632 made governor of Ireland. His administration here was severe and unjust. He maintained that Ireland was a conquered country, and treated it as such. His object was to make his master an absolute monarch by means of an executive system which he called "thorough," and he boasted that in Ireland the king was "as absolute as any prince in the whole world." It is generally admitted, however, that the material condition of the people improved under his government, in spite of his despotic measures. In January, 1640, he was created earl of Strafford and appointed lord lieutenant of Ireland. Later in the same year Charles put him in command of the army against the insurgent Scots, before whom the royal troops fled panic-struck, after the rout at Newburn (Aug. 28); and contrary to the strenuous advice of Strafford, the king accepted the terms imposed by the Scots. Dreading the meeting of the parliament which the king at this time, under compulsion, determined to summon, Strafford implored permission to return to Ireland. But Charles, pledging his royal word that "not a hair of his head should be touched by parliament," prevailed upon him to brave the issue. The assembly met on Nov. 3. On the 11th Pym appeared on the part of the commons at the bar of the house of lords, with a message of impeachment. The articles of impeachment accused Strafford of an attempt to subvert the liberties of the country. His guilt is placed beyond a doubt by evidence which has come to light since his death; but it was never proved by his accusers, and his defence, which he conducted himself with great eloquence and ability, was so strong that the house abandoned the original impeachment. A bill of attainder, brought into the lower house, was passed by a great majority. The lords, in a panic, complied; and the bill was sent to Charles for his approval. The king made some endeavors to save him, but apprehended popular violence if he refused a warrant for the execution; and Strafford advised him by letter, for the sake of the public peace, to sacrifice a life which would be resigned cheerfully to a master who had bestowed such "exceeding favors." He moved from his prison to Tower hill with dignity. "I lay down my head," said he, after declaring his innocence, "as cheerfully as ever I did when going to repose." His attainder was reversed under Charles II. His "Letters and Despatches" were edited by Dr. Knowler (2 vols. fol., London, 1739). His life has been written by Elizabeth Cooper (London, 1874).

**STRAITS SETTLEMENTS,** a British colony in Asia, consisting of islands in the strait of Malacca and detached portions of territory adjoining it. It is divided for administrative purposes into three provinces, Singapore, Malacca, and Wellesley, the last including the island of Penang, which will be found described under their own names. The area, and the population according to the census of 1871, are as follows:

| PROVINCES. | Area in sq. m. | Population. |
|---|---|---|
| Singapore | 224 | 97,111 |
| Malacca | 658 | 77,756 |
| Wellesley (mainland) | 236 | 71,433 |
| " (Penang) | 107 | 61,797 |
| Total | 1,225 | 308,097 |

Of the total population in 1871, 200,433 were males and 107,664 females; 103,936 were Chinese, 1,730 Europeans, and the remainder Malays and other East Indians. The Straits Settlements is a crown colony, and is ruled by a governor, resident in Singapore, who is under the direct control of the home government. Subordinate to him are two sub-governors, resident at Malacca and Penang, who have charge respectively of the provinces of Malacca and Wellesley. The colony, which is free commercially, had no public debt in 1871. The gross public revenue in that year was £298,712; expenditure, £266,499. The total value of imports in 1871 was £10,161,563, of which £2,374,106 were from the United Kingdom; of exports, £9,416,642, of which £2,119,732 were to the United Kingdom.—In 1851 the provinces now included in the Straits Settlements, which previously had been subordinate to the presidency of Bengal, were made a dependency of the crown under the governor general of India; and in April, 1867 (by act of Aug. 10, 1866), they were separated from India and created an independent crown colony.

**STRALSUND,** a strongly fortified seaport town of Prussia, in Pomerania, capital of a district of its own name, on the strait which separates the island of Rügen from the mainland, 125 m. N. by W. of Berlin; pop. in 1871, 26,731. The town is situated on an insular site, surrounded by the strait and several ponds, and can only be approached by bridges which connect it with its three suburbs on the mainland. It has a gloomy appearance, but is clean and well paved. The churches of St. Nicholas and St. Mary are fine specimens of the pointed style of architecture. The gymnasium has both a museum and a library. The manufactures include linen and woollen goods, starch, sugar, tobacco, soap, and leather. The town owns nearly 300 vessels, of about 70,000 tons. The chief exports are wheat, malt, timber, wool, and linen. The harbor is large, but shoals prevent vessels drawing more than 15 ft. from entering it.—Stralsund was built by Jaromar I., prince of Rügen, about 1209, and in the 14th century was one of the most important Hanse towns. It successfully resisted a memorable siege by Wallenstein in 1628. The Swedes gained possession of it by the peace of Westphalia, and Frederick William, elector of Brandenburg, captured it from them in 1678, but restored it in 1679. Stralsund surrendered to the Prussian, Danish, and Saxon forces in 1715, but was restored to Sweden in 1720. In 1807 it surrendered to the French, who destroyed part of the fortifications. By the treaty of Kiel in 1814 it was ceded to Denmark, and in 1815 Denmark surrendered it to Prussia.

**STRAMONIUM.** See DATURA.

**STRANGE, Sir Robert,** an English engraver, born in Pomona, one of the Orkney isles, July 14, 1721, died in London, July 5, 1792. While an apprentice in Edinburgh he joined the forces of the young pretender, and after the battle of Culloden took refuge in the highlands. He studied abroad for some years, and in 1751 settled in London as a historical engraver. During a visit to the continent in 1760 he executed many plates after the old masters. He was also a picture dealer, amassed a fortune, and was knighted in 1787. He wrote a "History of the Progress of Engraving," never published. There is a memoir of him by James Dennistoun of Dennistoun (2 vols. 8vo, 1855).

**STRASBURG, or Strassburg** (Fr. *Strasbourg*), a city of Germany, capital of Alsace-Lorraine, formerly of the French department of Bas-Rhin, on the Ill, a tributary of the Rhine, about a mile from the latter river, 90 m. S. S. W. of Frankfort, and 250 m. E. by S. of Paris; pop. in 1876, 94,000, two fifths Protestants. It stands on level ground, is nearly 6 m. in circuit, and is defended by a wall with bastions, ditches, and outworks, and a strong citadel constructed by Vauban. It is entered by seven gates, and the Rhine is crossed by a bridge of boats opposite Kehl. The Ill flows through the town in a N. E. direction, has many branches, and is crossed by several wooden bridges. The streets are generally crooked and narrow, but the principal ones are broad, and there are several fine squares. The houses are well built and rather lofty, with steep roofs. The cathedral, one of the finest Gothic buildings in Europe (see CATHEDRAL), was much damaged during the siege of 1870, but soon restored. It has a famous astronomical clock, constructed by Isaac Habrecht about 1570, one of the greatest works of its kind. Of the other churches the most interesting are those of St. Stephen, St. Thomas, the Temple Neuf, and St. Pierre le Jeune; and there is a fine synagogue. The city library, dating from 1531, was burned in 1870, during the war, with its 200,000 volumes; but

Strasburg Cathedral.

it has since been restored, and in 1874 contained 300,000 and in 1875 350,000 volumes. The university, founded in 1621, was reopened May 1, 1872, by the Germans, and in 1875 had more than 700 students. The military establishments are on an extensive scale. The manufactures include woollen, linen, and cotton goods, sail cloth, jewelry, clocks and watches, cutlery, hardware and cast-iron articles, porcelain, earthenware, soap, leather, straw goods, hosiery, paper, and cards. There are numerous bleach fields, dye works, sugar refineries, breweries, and printing offices; and the town is celebrated for its *pâtés de foie gras.* The trade of Strasburg is extensive, and is greatly facilitated by the navigation of the Rhine.—Strasburg occupies the site of the ancient Ar-

gentoratum, which after the Roman conquest was made a frontier fortress against the Germans. It was a free city of the empire during the middle ages, and was a Protestant city till seized by Louis XIV. in 1681. A Catholic bishopric of Strasburg, however, at the same time ruled a considerable territory on both sides of the Rhine. After about one month's siege and bombardment, the commander, Gen. Uhrich, capitulated to the Germans in the night of Sept. 27-28, 1870; and the city was finally incorporated with the German empire by the treaty of May 10, 1871. The fortifications as well as the town have since been much enlarged.—See Friese, *Vaterländische Geschichte der Stadt Strasburg* (4 vols., Strasburg, 1791-'5); Hermann, *Notices historiques, statistiques et littéraires sur la ville de Strasbourg* (2 vols., 1819); *Documents relatifs au siége de Strasbourg*, by Gen. Uhrich (Paris, 1872); *Geschichte der Belagerung von Strassburg*, by Reinhard Wagner (2 vols., Berlin, 1874); and the account of the siege in vol. ix. of the history of the war published by the German general staff (1875).

**STRATEGOS.** See p. 899.

**STRATFORD,** a town, port of entry, and the capital of Perth co., Ontario, Canada, on the Avon river, at the junction of the Grand Trunk railway with the Buffalo branch, 88 m. W. by S. of Toronto; pop. in 1871, 4,313. It has good water power, and contains manufactories of iron castings, mill machinery, agricultural implements, woollens, steam engines, leather, boots and shoes, &c., and several flouring mills, distilleries, and breweries. The railroad shops are very extensive. There are three branch banks, three weekly (one German) newspapers, a monthly periodical, and Baptist, Congregational, Episcopal, Methodist, Presbyterian, and Roman Catholic churches. The value of imports for the year ending June 30, 1874, was $1,026,038; of exports, $247,244.

**STRATFORD DE REDCLIFFE, Stratford Canning,** viscount, better known as Sir Stratford Canning, an English diplomatist, born in London, Jan. 6, 1788. In 1809 he was appointed secretary of embassy at Constantinople, in 1814 minister plenipotentiary to Switzerland, in 1820 a special commissioner at Washington, and in 1824 at St. Petersburg. He was ambassador to Constantinople from 1825 to 1827, and again from 1841 to 1858; and his diplomatic activity was very conspicuous both during the negotiations which resulted in the intervention of the western powers in favor of Greece, and during the opening period of the Crimean war. He was a warm friend of Reshid Pasha, and many important reforms in Turkey, particularly those affecting the condition of the Christian population, were attributed to his efforts. He was ennobled in 1852. He has published "Why am I a Christian?" (1873), and a play entitled "Alfred the Great in Athelney" (1876).

**STRATFORD-UPON-AVON,** a town of Warwickshire, England, on the right side of the river Avon, 8 m. S. W. of Warwick, and 82 m. N. W. of London; pop. in 1871, 3,863. The town exhibits the architecture of the 16th and

Shakespeare's Birthplace.

17th centuries. Annual fairs are held for the sale of horses, cattle, corn, and cheese. Stratford was a place of some consequence as early as the middle of the 8th century, but derives

Shakespeare's Tomb.

its chief interest now from the fact that it was the birthplace of Shakespeare, his abode in youth and age, and the place of his death and

burial. A part of the ancient house in which he is said to have been born, and which he retained to the time of his death, is still standing in Henley street; it has been purchased for the nation by subscription at a cost of about £4,000, and is as far as possible kept in the same condition as in his lifetime. A church near the river, a handsome cruciform structure with a fine tower and spire, contains his remains and those of his wife, in the vicinity of a monument, the distinguishing feature of which is the celebrated portrait bust of Shakespeare in marble. This edifice was thoroughly restored in 1840. The grammar school, in which, according to tradition, the great dramatist was educated, is established in the upper part of the ancient guildhall. In 1769 a Shakespeare "jubilee" was celebrated in Stratford under the direction of Garrick, on which occasion the present town hall, which contains a statue of the poet, was erected. The tercentenary of Shakespeare's birth was celebrated here, April 23, 1864.

**STRAUBING**, a town of Bavaria, in the district of Lower Bavaria, on the right bank of the Danube, 25 m. S. E. of Ratisbon; pop. in 1871, 11,150. It is one of the oldest towns of the kingdom. It has an ancient town hall, a Gothic church with fine pictures, and one with a celebrated monument of Duke Albert II., and a palace where Duke Albert III. resided with his wife Agnes Bernauer. (See BERNAUER.) Straubing has many breweries and tanneries.

**STRAUSS**, the name of four German musicians, father and three sons. JOHANN, the father, was born in Vienna, March 14, 1804, and died there, Sept. 24, 1849. In early life he was a member of Lanner's orchestra, afterward organized a band of his own, gave concerts in the chief cities of Germany, and soon rivalled Lanner as a composer and conductor. The eldest son, JOHANN, born in Vienna in 1825, has been for many years, by appointment of the emperor, music director of the court balls. Before the death of his father he had organized a band, whose playing has created the greatest enthusiasm in the chief capitals of Europe. In 1872 Strauss (without his band) visited the United States, and conducted the orchestra of 1,000 performers in his own compositions at the so-called world's peace jubilee in Boston. Before returning he gave three concerts in New York. Besides nearly 400 compositions of dance music, he has published four operettas which have met with considerable success: *Indigo* (1871), *Der Carneval in Rom* (1873), *Die Fledermaus* (1874), and *Cagliostro* (1875). JOSEF, who was born in Vienna in 1827 and died there in 1870, left nearly 300 compositions of dance music. The youngest brother, EDUARD, is the leader of an orchestra in Vienna, and has published nearly 200 compositions. The published compositions of the four Strausses are about 1,100 in number, all of which, excepting a few marches and the operettas above mentioned, are music for dancing. Between 300 and 400 are waltzes, many of which are classed as the best productions of this kind of music.

**STRAUSS, David Friedrich**, a German theologian, born in Ludwigsburg, Würtemberg, Jan. 27, 1808, died in Berlin, Feb. 9, 1874. He was educated at Blaubeuren and Tübingen, was curate in 1830 and professor at Maulbronn in 1831, and in 1832 became *Repetent* in the theological seminary at Tübingen, where he also lectured on the Hegelian philosophy in the university. His name was unknown when he published *Das Leben Jesu* (2 vols., Tübingen, 1835; translated by Marian Evans, now Mrs. Lewes, 3 vols., London, 1846; new ed., 2 vols., New York, 1860), which was republished by him in 1864, after the appearance of Renan's work on Jesus, under the title *Das Leben Jesu für das deutsche Volk bearbeitet* (latest ed., 1874). Its design is to critically establish for Christianity a mythical instead of a historical basis, to resolve the Gospels into popular legends, and the miracles into significant poetry. It supposes the existence of Jesus, an exemplary and reformatory rabbi of Galilee; that he lived and died an enthusiastic and admired teacher and innovator; that after his death many marvellous incidents concerning him gradually gained currency; that some of these were exaggerations of actual events, and others symbolical forms in which his disciples clothed his doctrines and precepts; that these wonderful narratives were not produced by single persons, but were the spontaneous outgrowth of poetical and philosophical tendencies in the early church, of which, after being circulated orally for about a century, various compilations were written. The second part of the work assigns a new meaning to the New Testament. The career of Christ symbolizes the moral history of mankind. Humanity is God manifest in the flesh, sinless, working miracles, dying, rising, and ascending to heaven. Thus the narrative applies not to an individual, but to the race; the dogmas are true, though the history is false. Strauss was deprived of his position as *Repetent*, and became a teacher at Ludwigsburg, and afterward in Stuttgart. In 1837 he replied to his critics by three volumes of *Streitschriften*, and in 1838 by *Zwei friedliche Blätter*, but subsequently availed himself of the new editions of his work to controvert his opponents. In 1839 he went to Zürich as professor of dogmatics and church history, but was soon dismissed with a pension, and his nomination resulted in the speedy downfall of the local radical government. In 1840 he married the vocalist Agnes Schebest, but was separated from her. In 1848 he was an unsuccessful candidate for the Frankfort parliament, but was elected to the diet at Stuttgart, from which he withdrew in December on account of the unpopularity of his political conservatism. In 1872 he returned to his native town after a long residence at Darmstadt. His other prin-

cipal works are: *Die christliche Glaubenslehre in ihrer geschichtlichen Entwickelung und in ihrem Kampfe mit der modernen Wissenschaft* (2 vols., Tübingen, 1840–'41); *Der Romantiker auf dem Throne der Cäsaren, oder Julian der Abtrünnige* (Mannheim, 1847); *Ulrich von Hutten* (3 vols., 1858–'60; 2d ed., 1871; English translation by Mrs. Sturge, London, 1874); *Voltaire* (1870; 3d ed., 1872); *Krieg und Friede*, his correspondence with Renan on the Franco-German war (1870); and *Der alte und der neue Glaube, ein Bekenntniss* (1872), showing the contrast between liberty of thought and ecclesiastical domination, and adhering to the latest results of scientific investigations and to materialistic views of the universe. This last of his works created a no less profound sensation than his first. Charles Ritter has published a selected French translation of his minor essays, under the title of *Essais d'histoire religieuse et mélanges littéraires*, with an introduction by Renan (Paris, 1872).—See *David Friedrich Strauss in seinem Leben und seinen Schriften geschildert*, by Eduard Zeller (Leipsic, 1874; English translation, London, 1874).

**STRAW**, the stem of cereal grasses. On the farm it is used as fodder, for littering animals, as manure, and for thatching outhouses and stacks of hay and grain. It is much used for mattresses called palliasses (Fr. *paillasse*, from *paille*, straw). It is employed to some extent for ornamental purposes, as for picture frames and baskets for cut flowers. The Japanese use many-colored straws in ornamenting the exterior of cabinets, work-boxes, &c. In the arts the chief uses of straw are for paper making (see PAPER) and for the manufacture of hats and bonnets. The art of plaiting straw and similar materials is very ancient, and is found in various stages of perfection in every quarter of the globe. In Europe it remained in a comparatively rude state down to the end of the 16th century, when it began to attain commercial importance in France and northern Italy. James I. introduced it into England. The Leghorn plait of Tuscany began to acquire a European celebrity late in the 18th century; it is still unsurpassed. In that portion of Italy a peculiar variety of wheat (*triticum turgidum*) is grown solely for the straw, which is distinguished for its slenderness and strength. The seed grain is grown in the Apennines, and the straw crop on the lowlands, for which it is sown very thickly. The plant is cut before maturity, and left on the ground to dry in the sun, and then tied in bundles and stacked. It is afterward spread out on the ground again to be bleached in the sun and dew, and is finally steamed and fumigated with sulphur. In Tuscany the straws are sorted by women, who can instantly by the touch detect the slightest shades of difference in their thickness. In other countries the sorting is done by means of a series of graduated sieves. The Tuscan straw, owing to its fineness, is plaited as it comes from the hands of the sorter; other kinds must be split into splints for fine work. At first the splitting was done with a knife, but it is now done by passing into each straw a wire with several cutting edges, or more expeditiously by drawing the whole straw over a sharp steel comb. As the split straw when plaited presents alternately its inner and outer surface, the work lacks that uniformity of appearance produced by the whole straw. To secure this, the plan was devised, in the plait called the "patent Dunstable," of laying two splints with their inner surfaces together, which also increases its durability. The plaits are of various widths, depending on the number and thickness of the straws. The usual length in Italy is about 50 metres (54 yards), in England 20 yards. In Tuscany the plaits are coiled spirally into a flat, the edges being knit together and held fast by a thread concealed within the fabric; elsewhere they are usually wound around a block of the shape required, the edges overlapping and the successive coils stitched together. The first straw bonnet braided in the United States is said to have been made in 1798 by Miss Betsey Metcalf, of Providence, R. I. Large numbers of women and children were employed at one time in this country in plaiting straw, but now almost all the braid used is imported. Straw hats and bonnets are sewn in the United States almost entirely by the Bosworth straw-sewing machine, on which when run by steam 100 ordinary hats can be made in a day. There are four companies in Massachusetts and one in Connecticut each of which employs about 100 of these machines, and they are also used by several smaller companies. The hats are pressed by another machine, also of American invention, which smooths them ready for trimming at the rate of four a minute. The value of the straw goods manufactured in the United States in 1870, as reported in the census, was $7,282,086, distributed among nine states: California, $60,700; Connecticut, $1,026,000; Massachusetts, $4,869,514; New Jersey, $54,530; New York, $1,006,000; Pennsylvania, $189,242; Rhode Island, $40,000; Vermont, $1,600; Wisconsin, $34,500. The number of men employed was 1,988; women, 12,594; youths under 16, 343. During the year 1874–'5 the value of the product of Massachusetts increased about 25 per cent., while that of most of the other states has remained nearly the same.—In Ecuador, Colombia, and other parts of South and Central America, a straw is obtained from the *Carludovica palmata*, called by the natives *jipijapa* or *portorico*, which is largely used in the manufacture of the hats known as Panama hats, from the principal port of their shipment, cigar cases, &c. The leaves of the plant, which resembles a palm, are gathered before they unfold, and after the ribs and coarser veins have been removed are cut into shreds. These are exposed to the sun for a

day and then tied into a knot and immersed in boiling water until they become white, when they are hung up in the shade and afterward bleached for several days. The straw is then distributed through the districts, especially in Peru, where the manufacture is carried on. Whole colonies of Indians are engaged in this manufacture. The men, women, and children plait the straw upon a block of wood which they hold between their knees, finishing an ordinary hat in two or three days; but the finest hats occupy several months to complete them, and require especial care in the selection of the straw and the plaiting. The best are made in Ecuador.

**STRAWBERRY,** a well known wild and cultivated fruit, the Anglo-Saxon name of which, *streawberige* or *streowberie*, was probably derived from the straw-like stems of the plant or from the berries lying strewn on the ground. The several species belong to the genus *fragaria* (from the ancient Latin name *fraga*), of the rose family; they are stemless perennial herbs, with compound leaves of three obovate, wedge-shaped, coarsely serrate leaflets, and multiply by runners, which are long weak branches, forming a bud at the end which soon develops roots and leaves, and by the decay of the branch connecting it with the parent becomes an independent plant. The flowers are in a cyme at the end of an erect scape, with a five-lobed, spreading, persistent calyx, and as many bractlets alternating, and thus appearing ten-cleft; petals (mostly white) five; stamens numerous; pistils simple, seated upon a convex receptacle, which when the ovaries are ripe is greatly enlarged, becoming pulpy and edible, and is popularly regarded as the fruit; it is really the much altered end of the stem (see Plant), while the true fruits are the small seed-like akenes, the ripened ovaries, which are scattered over its surface or sunk in little depressions. By abortion of the stamens some of the species become more or less diœcious.—The strawberry is found in all temperate parts

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of the northern hemisphere and in the mountains of South America. While Bentham and Hooker state that there are not more than three or four well defined species, a dozen or more have been described, the plants being, even in the wild state, very variable, while the varieties in cultivation resulting from hybridizing, crossing, and sporting are innumerable. Two species are widely distributed throughout the United States, and one is peculiar to the Pacific coast. The Virginian or common wild strawberry (*fragaria Virginiana*) is found from arctic America to Florida, and west to the Rocky mountains. Its leaves are rather thick, smooth on the upper surface, often shining; the hairs silky and appressed; the calyx erect after flowering; fruit mostly globular, with a narrow neck, and the akenes (seeds) sunken in deep pits in the surface of the receptacle. This has been described under many

Alpine Strawberry (Fragaria vesca).

different names, as it varies greatly, and the western forms appear very different from the eastern. The Alpine strawberry (*F. vesca*), the common species of Europe, is indigenous to this country, especially far northward, extending to Oregon and the N. W. coast; it is found throughout Europe and northern and central Asia. It has thin pale green leaves, the upper surface strongly marked by veins; flower stalks longer than the leaves; calyx remaining open after flowering; receptacle conical or elongated, with the akenes attached to the surface, and not as in the preceding sunk in pits. A taller form is known as the wood strawberry. This was the earliest species cultivated, and is mentioned in the street cries of London of over 400 years ago; the garden of the bishop of Ely at Holborn was in 1483 celebrated for its strawberries, a fact alluded to by Shakespeare in "Richard III." A number of varieties of this are cultivated, but they are more popular in Europe than in this country. The Chilian strawberry (*F. Chilensis*, the *F. grandiflora* of some) is found on the Pacific coast from Oregon southward; it is very robust, with leathery, thick leaflets of a dark green, and sometimes silky on both surfaces, or only below; the flowers are larger than in any other species, and the large yellowish white or rose-colored fruit, sometimes as large as a small hen's egg, erect. This was introduced into the south of France in 1712, and many valuable varieties resulted

from hybridizing it with other species. The Indian strawberry (*F. Indica*) is from upper India, and is naturalized in the southern states; it differs so much from the other species that it was formerly placed in a distinct genus (*Duchesnea*); it has yellow flowers, and is a showy house plant, especially for window baskets, but the fruit is dry and tasteless.—Of the cultivated American varieties, some are pistillate only, and must be planted near perfect flowered varieties, in order that they may be fertilized and bear fruit. The present tendency of cultivators is to discard all unisexual kinds. The great step in their improvement was in the production of "Hovey's seedling," raised by C. M. Hovey of Cambridge, Mass., over 40 years ago; it is a nearly pure Virginian, and has not been excelled if equalled in quality; it is a pistillate, and needs careful cultivation. The next great step was in the production of "Wilson's Albany," or "Wilson" as it is generally called, a most hardy and productive variety, with perfect flowers. Besides the above, the leading American varieties are "Agriculturist," "Seth Boyden," "Charles Downing," "Donner's Prolific," "Kentucky," "Nicanor," and "Monarch of the West." Among the European kinds which succeed here on suitable soils are "Triomphe de Gand," "Jucunda," and "La Constante."—The cultivation of the strawberry is now an important branch of horticulture, the fruit being sent to the city markets from great distances, especially by water. In New York city the first supplies come from Georgia and the Carolinas; then Virginia, Maryland, and Delaware send large quantities before the New Jersey season begins; this lasts three or four weeks, and then the later fruit comes from Connecticut and Massachusetts. The culture requires a well fertilized soil; the plants are formed by runners as already described; they may be set in autumn or spring, but the plants must grow one year in place before they give a crop. The method of planting and cultivation varies. In the annual method, the plants are set in rows two feet apart and a foot apart in the rows; one crop is taken and the plants are ploughed under, another field being ready to come into bearing to take its place. Another method is to plant in the same manner, let the plants run, and the next spring, when the spaces or paths between the rows are filled with new plants, to plough out other paths, turning under the old plants and allowing the new ones to bear fruit; if the alternate spaces are well manured, this method may be continued indefinitely. Still another plan is to cut off all runners as they start, and induce the plants to form large clumps or stools; some varieties do better in this manner than others; it is the best plan for gardens, as the plants continue in bearing three or four years. In northern localities the ground is covered with straw or leaves to prevent injury by frequent freezing and thawing, and this is left on until the fruit is picked, to keep it from being soiled. New varieties are produced from seed, from flowers carefully cross-fertilized or not, sown as soon as ripe; the seedlings come up in four or six weeks, and if protected during the winter and transplanted the next spring, they will bear fruit the following year.



**STRAYS.** See ESTRAYS.

**STREET, Alfred Billings**, an American poet, born in Poughkeepsie, N. Y., Dec. 18, 1811. A lawyer by profession, in 1839 he settled in Albany, where for a number of years he was state librarian. He has published "The Burning of Schenectady, and other Poems" (1842); "Drawings and Tintings," poems (1844); collected poems (1846); "Frontenac," his longest poem (1849); "The Council of Revision," containing the vetoes of the council, a history of the courts of New York, and biographical sketches of governors and judges from 1777 to 1821 (8vo, 1860); "Woods and Waters, or the Saranacs and Racket," a description of a tour in the great northern wilderness of New York (1860); "Forest Pictures in the Adirondacks" (1864); and "The Indian Pass" (1869).

**STRELITZ.** See MECKLENBURG.

**STRENGTH OF MATERIALS**, the resistance offered by the materials of construction to change of form or to fracture. 1. The resistance of materials to external forces tending to overcome their cohesion is classified, according to its forms, as follows:

| | |
|---|---|
| Longitudinal. | Compressing, resisting pulling asunder.<br>Tensile, resisting crushing. |
| Transverse.... | Bending, resisting cross breaking.<br>Shearing, resisting cutting across.<br>Torsional, resisting twisting or wrenching. |

Two or more of these forms of resistance are sometimes called into action simultaneously, as in the case of the crank of a steam engine, which tends to break the shaft both by a transverse strain and by torsion. 2. The "ultimate strength" is the maximum resistance offered to rupture. The "proof strength" is a less degree of resistance, which the body may safely offer when tested. The "working load" is some fractional part of the ultimate strength which may be selected as giving perfect safety against anticipated strains for an indefinite period. 3. The "factor of safety" is the ratio of the ultimate strength to the working load. The following are minimum values of this quantity adopted in what is generally considered good practice, under "dead" and "live" loads, and where the latter are liable to be accompanied by heavy shocks:

| MATERIAL. | Dead load. | Live load. | Shock. |
|---|---|---|---|
| Wrought iron............ | 3 | 5 | 8 |
| Steel.................... | 3 | 6 | 8 |
| Cast iron................ | 4 | 8 | 10 |
| Timber................... | 4 | 8 | 10 |
| Masonry.................. | 6 | 10 | .. |

4. The proof strength is usually, and should be always, below the elastic limit, *i. e.*, the point at

which set becomes proportional, or nearly so, to the distortion produced by the applied force. It is generally about one half or one third the ultimate strength. 5. Tensile resistance, or tenacity, is determined by experiment for each material. The ultimate strength or breaking load of any piece is measured by the product of the area of fractured section into the tenacity of the material of which it is composed; *i. e.*, $P=TK$, and $K=\frac{P}{T}$, where P represents the breaking force, T the tenacity of the material, and K the area of section. Values of T are given in the accompanying table of coefficients of resistance. The very best grades should have values 20 per cent. higher. P and T are taken in pounds upon the square inch. 6. When thin cylinders are exposed to internal pressure, as in steam boilers, steam cylinders, &c., the bursting pressure may be determined by multiplying the thickness of the shell by the tenacity of the material, as given above, and dividing by the semi-diameter. To ascertain the thickness, the pressure and the diameter of the cylinder being given, multiply the pressure by the semi-diameter, and divide by the tenacity of the material as given in the table; or $P=\frac{Tt}{r}$, and $t=\frac{Pr}{T}$, where $P$ = pressure, $t$ = thickness, $T$ = tenacity, and $r$ = radius of the cylinder. If $d$ = diameter, $P=2\frac{Tt}{d}$, and $t=\frac{Pd}{2T}$. Where the joints are double-riveted, the strength at the joints is usually about 0·7 that of the solid plate; single-riveted joints have 0·56 the strength of a solid plate. The mean strength of single-riveted boilers, where the joints are properly shifted, or "broken," is nearly or quite five eighths that of solid plate. A sphere will bear twice as much internal pressure as a cylinder of the same diameter. A thick cylinder is not as strong relatively as a thin cylinder of the same material, and no cylinder, however thick, can withstand an internal pressure exceeding its limit of tenacity, T, as given above. The rule for calculating the strength of a thick cylinder is expressed algebraically thus: $P=T\frac{R^2-r^2}{R^2+r^2}$, and $\frac{R}{r}=\sqrt{\left(\frac{T+P}{T-P}\right)}$, where $r$ = internal radius, $R$ = the external radius, and other values as before. For thick spheres, $P=T\frac{2R^3-2r^3}{R^3+2r^3}$, and $\frac{R}{r}=\sqrt[3]{\left(\frac{2T+2P}{2T-P}\right)}$. 7. The stayed surfaces are usually the strongest parts of a steam boiler. The following formula gives the proper distance between stays, where $t$ = thickness of plate, $P$ = the pressure in pounds per square inch, and $F$ = the factor of safety: $d=\frac{365t}{5FP}$. $P=F\left(\frac{365t}{d}\right)^2$. 8. Bolts, rivets, and lugs are usually exposed to shearing strain. The resistances to shearing of the most commonly used materials are to be taken as equal to the tensile strength. Where shearing is to be resisted, the parts should be fitted with great care, to avoid the possibility of cutting, and to insure that all parts of the cross section attacked shall resist the shearing force as nearly as possible together. Where a pin is fitted but not forced into its socket, the resistance to shearing is taken as three fourths of that due the section exposed to rupture. 9. Crushing is resisted by any given material with a force that varies very greatly with the form given it. Very short columns or compact masses resist very high crushing strains, in consequence of the resistance offered by their particles to dispersion, as well as by their cohesion. Tall columns first bend and then break under a comparatively slight force. The figures in column C of the table give the resistance to crushing when bending does not occur. Seasoned timber has nearly twice as great resistance to crushing as green. Steel should not be used under pressure exceeding its compressive elasticity, which, in tool steel, is about 50,000 lbs. to the square inch. Wrought iron should not be used under pressure exceeding 25,000 lbs. to the square inch. 10. For tall columns, the following formulas were proposed by Prof. Eaton Hodgkinson:

| MATERIALS. | Rounded ends. | Flat ends. |
|---|---|---|
| Solid cylindrical cast-iron columns......... | $W=14{\cdot}9\frac{D^{3\cdot76}}{L^{1\cdot7}}$ | $W=44{\cdot}2\frac{D^{3\cdot55}}{L^{1\cdot7}}$ |
| Hollow cylindrical cast-iron columns...... | $W=13\frac{D^{3\cdot76}-d^{3\cdot76}}{L^{1\cdot7}}$ | $W=44{\cdot}3\frac{D^{3\cdot55}-d^{3\cdot55}}{L^{1\cdot7}}$ |
| Solid cylindrical wrought-iron columns...... | $W=42\frac{D^{3\cdot76}}{L^2}$ | $W=133{\cdot}7\frac{D^{3\cdot55}}{L^2}$ |
| Solid square pillar of Dantzic oak.......... | .................... | $W=10{\cdot}9\frac{D^4}{L^2}$ |
| Solid square pillar of red pine.......... | .................... | $W=7{\cdot}8\frac{D^4}{L^2}$ |

In these formulas $W$ = crushing weight in tons, $D$ = outside diameter in inches, $d$ = inside diameter in inches, $L$ = length in feet, and $D < {\cdot}4L$; *i. e.*, the columns are more than 30 diameters in length. Prof. Rankine gives $P=\frac{fS}{1+a\frac{l^2}{D^2}}$ for tall columns. $P$ = crushing load in pounds; $S$ = sectional area in square inches; $l$ = length and $D$ = external diameter, both being in the same units of measure, whether feet or inches. The following are the values of $f$ and $a$:

| MATERIALS. | Value of $f$. | Value of $a$. | Forms of column. |
|---|---|---|---|
| Cast iron.......... | 80,000 | $\frac{1}{400}$ | Hollow cylinder. |
| Wrought iron..... | 36,000 | $\frac{1}{3000}$ | Solid rectangle. |
| " " ..... | 36,000 | $\frac{1}{6000}$ | Thin square tube. |
| " " ..... | 36,000 | $\frac{1}{2250}$ | Solid cylinder. |
| " " ..... | 36,000 | $\frac{1}{4500}$ | Thin cylinder. |
| " " ..... | 36,000 | $\frac{1}{1500}$ | Angle iron. |
| " " ..... | 36,000 | $\frac{1}{1500}$ | + shaped. |
| Best American wrought iron... | 50,000 | .... | For all shapes. |
| Timber.......... | 6,500 | $\frac{1}{250}$ · | Solid rectangle. |

This formula is frequently designated as Gordon's, having been deduced by Gordon from Hodgkinson's experiments. Multiply the value of $a$, as given in the table, by 4 for columns rounded or jointed at both ends, and by 2 where fixed at one end, rounded at the other. Connecting rods of steam engines are calculated as pillars rounded at both ends. Piston and pump rods are considered as fixed at one end, free at the other. 11. The collapsing of boiler flues was made the subject of a series of experiments by Mr. Fairbairn, and the following formula was deduced: $P = 806{,}000\,\frac{t^{2\cdot19}}{Ld}$, where $P$ = collapsing pressure in pounds per square inch, $t$ = thickness of iron in flues, $L$ = length of flue in feet, and $d$ = its diameter in inches. When the flue is strengthened by angle-iron rings, as is sometimes done with long flues, L is taken as the distance between the rings. This formula has not been verified for short flues of great diameter, or for exceptional proportions. A slight deviation from a truly cylindrical form considerably reduces the strength of the flues; $t^2$ is generally taken instead of $t^{2\cdot19}$. Elliptical flues, having a major diameter $a$ and a minor diameter $b$, are of equal strength with a cylindrical flue of the diameter $2\frac{a^2}{b}$. 12. The transverse strength of beams may be calculated by the following formulas:

$W=\frac{Kbd^2}{L}$ and $W=\frac{KAd}{L}$ for beams fixed at one end and loaded at the other.

$W=2\frac{Kbd^2}{L}$ and $W=2\frac{KAd}{L}$, where fixed at one end and uniformly loaded.

$W=4\frac{Kbd^2}{L}$ and $W=4\frac{KAd}{L}$, where supported at both ends and loaded at centre.

$W=8\frac{Kbd^2}{L}$ and $W=8\frac{KAd}{L}$, where fixed at both ends and loaded at centre.

$W=8\frac{Kbd^2}{L}$ and $W=8\frac{KAd}{L}$, where supported at both ends and uniformly loaded.

$W=12\frac{Kbd^2}{L}$ and $W=12\frac{KAd}{L}$, where fixed at both ends and uniformly loaded.

Here $W$ = breaking weight in pounds, $K$ = a coefficient which varies with every change in form of cross section of the beams, $d$ = depth of beam in inches, $b$ = breadth in inches, $A$ = area of cross section of the beam at point of rupture in square inches, and $L$ = length between supports in feet. The values of K given in the table, where the beams are of rectangular section, fixed at one end and loaded at the other, are obtained from various sources. 13. For other than rectangular sections the following may be taken as the values of K for cast iron: Shape, ; value, K = 500. Shape, , equal flanges; value, K = 520. Fairbairn, ; value, K = 580. Hodgkinson, ; value, K = 850. The following values are given for wrought iron: rolled rails, , 600; Fairbairn's riveted beam, , 900; box beam, , 1,000. 14. For the wrought-iron beam, when supported at both ends and uniformly loaded, the formula $W=\frac{8D\left(a+\frac{a'}{6}\right)S}{L}$ is used by some American manufacturers. $D$ = depth in feet; $a$ = area of flange in inches, $a$ = that of "stem" or web; $S$ = stress per square inch of area, $a+\frac{a'}{6}$, in tons. The deflection, $S=\frac{.006WL^3}{\left(a+\frac{a'}{6}\right)d^2}$, where the load is applied at the middle, and $S'=\frac{.004WL^3}{\left(a+\frac{a'}{6}\right)d^2}$ when applied uniformly. The depth D is measured between the centres of gravity of the flanges. In such beams it is customary to allow as maxima 10,000 lbs. per square inch in tension and 6,000 to 8,000 in compression. Deflection should not exceed $\frac{1}{30}$ of an inch per foot of length, in any structure. 15. Torsional strength is computed by the formula $W = S'\frac{D^3}{R}$; $D = \sqrt[3]{\frac{WR}{S'}}$; where $W$ = breaking weight in pounds, $D$ = diameter of shaft in inches, and $R$ = length of lever arm in feet. The coefficient $S'$ is very nearly proportional to the tenacity of the material, where the torsion is equal in degree. 16. Resilience is a term introduced by Dr. Young. It is measured by the amount of work performed in producing the maximum strain which a given body is capable of sustaining, and is the quality of primary importance where shocks are to be sustained. Mallet's coefficient of resilience is the half product of the maximum resistance into the maximum extension. But for tough metals it is equal approximately to two thirds the product of the ultimate strength of the material by the distance through which the body yields before the straining force. For very brittle materials it is measured by half that product. No material can resist the shock of a body in motion, unless it is capable of offering resilience equal to the amount of work performed in setting that body in motion at the given velocity; *i. e.*, equal to the amount of energy stored in the moving mass at the instant of striking. In predicting the effect of shock, therefore, it becomes necessary to know the amount of energy stored in the moving body and the resilience of the resisting material. To meet a violent shock successfully, resilience, rather than mere strength, must be secured. As an instance, it is found that wrought iron of comparatively low tenacity but great toughness, capable of stretching considerably before fracture, is far superior to steel for armor for iron-clad ships; the latter has much greater strength, but also greater brittleness. Such calculations are not usually made in designing. Immunity from the injurious effect of shock is

secured by the use of a large factor of safety in proportioning parts exposed to them, by care during construction in the selection of tough resilient materials, and in management by carefully adjusting all parts, and applying the load so as to avoid jarring action as far as possible. 17. If a weight, acting as a steady load, produces a given deflection or change of dimensions, it will require but half that weight suddenly applied to produce a similar effect, whether it be fracture or a stated alteration of form. The extension of ordinary wrought iron within its limit of elasticity is about ·0001 per ton per square inch of section. The amount of extension before fracture by tension is given, with the finest quality of wrought iron, at 20 per cent., with medium quality 16 per cent., and it runs in some irons as low as 4 per cent. Cast iron of fair quality is elongated but a fraction of 1 per cent. 18. The extension of steel varies with the amount of carbon, and nearly inversely as its tenacity. The following table is taken in part from Trautwine's "Engineer's Pocket Book:"

ULTIMATE TENSILE STRENGTH IN POUNDS PER SQ. IN., AND ELONGATION IN INCHES, BEFORE BREAKING.

NOTE.—The specimens tested were steel bars of different grades made from pure Swedish iron, and each bar was turned to a diameter of one inch for a length of 14 inches.

| SPECIMENS. | Per cent. of carbon. | Breaking weight. | Elongation. | Resilience. |
|---|---|---|---|---|
| No. 1........... | 0·33 | 68,100 | 0·098 | 4,450 |
| No. 2........... | 0·43 | 76,160 | 0·089 | 4,970 |
| No. 3........... | 0·48 | 84,000 | 0·089 | 5,040 |
| No. 4........... | 0·53 | 95,200 | 0·080 | 5,080 |
| No. 5........... | 0·58 | 92,960 | 0·058 | 3,600 |
| No. 6........... | 0·63 | 100,800 | 0·071 | 4,770 |
| No. 7........... | 0·74 | 101,920 | 0·050 | 3,400 |
| No. 8........... | 0·84 | 123,200 | 0·080 | 6,580 |
| No. 9........... | 1·00 | 134,400 | 0·071 | 6,360 |
| No. 10.......... | 1·25 | 154,560 | 0·044 | 4,530 |

In the larger table, the ultimate resilience of metals is given as tested in the Stevens institute of technology, Hoboken, N. J. Phosphor bronze considerably exceeds ordinary bronze in ductility and resilience. 19. Heating wrought iron within certain limits, and then cooling under stress, increases its strength by relieving internal strain. Cold rolling and wire-drawing increase it, in some cases, 100 per cent. Mr. Dean of Boston and Uchatius of Vienna have similarly increased the strength and elasticity of bronze. Overheating, annealing, and cold hammering decrease its strength. Cast iron of open structure and low density is increased in strength by successive remeltings, sometimes to the amount of 100 per cent., over pig metal. Casting under a head, or under considerable pressure, similarly benefits both cast iron and cast steel. Sir Joseph Whitworth produced a steel of extraordinary strength and toughness by casting under heavy pressure. The internal strain consequent upon sudden cooling, or upon cooling awkwardly shaped castings, seriously reduces their strength and sometimes produces actual fracture. The character of cast iron is largely determined by its density, 7·2 to 7·3 representing the best limits for ordinary practice. Cold wrought iron is more than twice as strong as red-hot. Strength, ductility, and resilience increase with diminishing temperatures, when the materials are of good quality. Cold-blast cast iron is usually stronger than hot-blast iron made from the same ores. Copper loses 25 per cent. of its tenacity at 550° F., 50 per cent. at 810°, and 67 per cent. at 1,000°, the diminution of tenacity varying nearly as the square root of the third power of the temperature. Metals in large masses have usually less density and strength than when worked into sheets, bars, or wire. Wrought iron is particularly liable to loss of strength in large forgings. Bars two inches in diameter being made of the same metal as other bars one inch in diameter, the latter are sometimes found to have 20 per cent. more strength. Steel exhibits even greater differences. 20. Indentation is resisted by wrought iron nearly in proportion to its thickness. Fairbairn found the force necessary to push a blunt point or a ball 3 in. in diameter through boiler plate, one quarter of an inch thick, to be 17,000 lbs., and nearly equal to that required to drive the same instrument through a three-inch oak plank. Resistance of armor plate to penetration by shot varies, if the plate be well backed, as the square of thickness, within the limit of moderate thickness. The material should be strong and ductile. 21. Generally, in designing machines or parts of machines, they should be so proportioned that all parts will have factors of safety of nearly equal value. Economy of material is thus secured, and also the very important advantage, where exposed to severe shock or sudden strains, of utilizing the resilience of the whole machine in resisting them. Forms of uniform strength should therefore be used wherever possible. Suspension rods of uniform strength must have a greater section at the point of support than at the point of attachment of the load, as the upper portions carry not only the load but the weight of the lower part of the rod. Pump rods and wire ropes for deep mines are for this reason made tapering, with the largest section at the top. Care should always be taken that the pieces connected and their fastenings are, when possible, equally strong. Tall columns are slightly swollen at the middle portion in order that they may be equally liable to break at all points, and the Hodgkinson form of cast-iron beams, and the Fairbairn (I) form of section of wrought-iron beams, are given their peculiar shapes in order that no surplus material may exist in either top or bottom flange. Beams of uniform strength, when fixed at one end and loaded at the other, if of uniform depth, are triangular in plan. If uniformly loaded, they represent in plan a pair of parabolas whose vertices touch at the outer end. When of uniform breadth, their vertical sections are parabolic in the first

case, and triangular in the second. Beams of uniform depth, supported at the ends and loaded at the middle point, are in plan a pair of triangles with a common base at the load. If uniformly loaded, the plan is a pair of parabolas with their bases at the middle of the beam. When supported at the ends and uniform in breadth, they are in vertical section a pair of parabolas, in the first case with vertices at the ends and bases meeting at the load, and in the last case semi-ellipses extending between the points of support. In building bridge girders, economy of material is secured by the use of isosceles bracing set at angles of 45°. In vertical and diagonal bracing, the proper angle for diagonals is 55° measured between the diagonal and the vertical. The amount of resistance of a cylinder to rupture by torsion is nearly double that to breaking across. Bolts exposed to shocks and sudden strains, as when used as armor-plate fastenings, are found to resist much more effectually where resilience is secured by turning down the shank to the diameter of the bolt at the bottom of the thread, or otherwise creating a uniform area of section between head and nut. Punching rivet holes weakens plates of hard iron and steel. The latter are injured so seriously that steel plates are never punched by careful engineers. (See STEEL.) In hard iron the reduction of strength is often considerable (15 per cent. as shown by some experimenters); and in many cases, in boiler work, for this reason, the rivet holes are all drilled, notwithstanding the increased cost. Where the iron is very soft and ductile, punching produces less injury. 22. Elasticity is that quality by the possession of which the strain, or distortion of form, produced in any body by stress, is wholly or partially removed on the removal of the stress. All bodies have more or less elasticity, and, when perfectly homogeneous and free from internal strain, are perfectly elastic within a certain limit, which is called the limit of elasticity. Within this limit, the displacement produced by any force is directly proportional to that force. Beyond the limit of elasticity, the strain produced by stress is not wholly removed on the cessation of the stress. The permanent change of form so produced is called the "set." This set takes place on the application of the slightest force where the material is not uniform in character and free from internal strain. Hodgkinson found that in iron, far within the elastic limit, the lightest loads produced slight set. Beyond the elastic limit the set becomes nearly proportional to the distortion, the resistance also increasing up to the point at which rupture begins, but in a far higher ratio. Repeatedly straining a piece beyond its elastic limit produces "fatigue" and ultimate fracture. This may occur by the application of force far less than that producing immediate rupture. 23. The modulus of elasticity, sometimes called the coefficient of elasticity, is the quotient obtained by dividing the measure of the force producing distortion by the measure of the distortion produced by it. Its value varies with every material. The ordinary values of the modulus are given in the table. These values, as is proved by autographic strain diagrams, are liable to variation, within very wide limits, by every circumstance which affects the physical character of the materials. It has no fixed relation to the ultimate strength. It will be seen that this quantity may be defined as the measure of that force which, supposing no limit to elasticity, would shorten or lengthen a bar, originally a unit in length, to the extent of one unit. Thus, a bar of ordinary forged iron, one foot long, would be altered in length $\frac{1}{10,000}$ by a force equal to $\frac{25,000,000}{10,000} = 2500$ lbs. per square inch of section. 24. *Testing Machines.* The strength of materials is determined by means of testing machines. 25. Fig. 1 represents a machine for determining longitudinal resistance, as built by the Messrs. Riehlé of Philadelphia. It consists of a weigh-beam, accurately made and

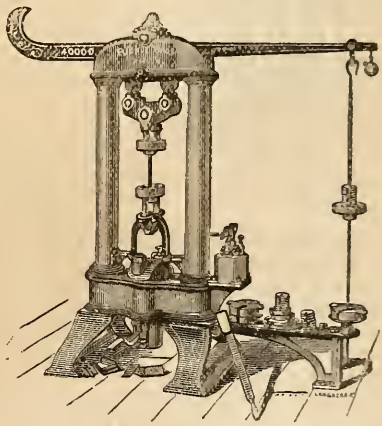


FIG. 1.—Riehlé's Longitudinal Testing Machine.

nicely poised upon knife edges. At its outer end it sustains a scale pan upon which weights measuring 2,000 or 4,000 lbs. are placed. Intermediate weights are measured by a poise, not shown in the figure, which traverses the beam, the latter being divided into parts of 10 lbs. each, similarly to the steelyard balance. The specimen is secured at the upper end by wedges or clamps, in a strong collar which is hung from two knife edges, one on each side the knife edge carrying the scale beam. These knife edges are placed at slightly different distances from the knife edge supporting the beam, thus making the latter a "differential lever," and permitting the measurement of a very great force without compelling the use either of large weights or of a series of levers. A similar collar below takes the lower end of the specimen to be tested. This second collar is secured to the head of a hydraulic press which is placed within the lower part of the frame of the machine. A small pump, worked

by a hand lever, is used to force oil into the press. The breaking force is thus applied from below, and is measured upon the lever above. 26. With the autographic recording testing machine of Prof. R. H. Thurston, fig. 2, nearly all of the essential qualities as well as the strength of materials are determined by the automatic production of a strain diagram. This diagram is an exact graphical representation of all circumstances attending the distortion and fracture of the specimen. No system of personal observation yields results as trustworthy or with such precision as an autographic registry. No other method gives simultaneously, and at every instant during the test, the intensity of the distorting force and the magnitude of the coincident distortion. In this machine two strong wrenches are carried by the A frames, and depend from axes which are both in the same line, but which are not connected with each other. The arm of one of these wrenches carries a weight at its lower end. The other arm is designed to be moved by hand in the smaller machines and by a worm gear in larger ones. The heads of the wrenches are fitted to take the head on the end of the test pieces, which are usually given the form shown in fig. 3. A guide curve of such form that its ordinates are precisely proportional to the torsional moments exerted by the weighted arm while moving up an arc to which the corresponding abscissas of the curve are proportional, is secured to the frame next the weighted arm. The pencil holder is carried on this arm, and as the latter is forced out of the vertical position, the pencil is pushed forward by the guide curve, its movement being thus made proportional to the force which, transmitted through the test piece, produces deflection of the weighted arm. The guide curve is a curve of sines. The other arm carries the cylinder upon which the paper receiving the record is clamped, and the pencil makes its mark on the table thus provided. This table having a motion, relatively to the pencil, which is precisely the angular relative motion of the two extremities of the test piece, the curve described upon the paper is always of such form that the abscissa of any point measures the amount of the distortion which the force produces. 27. The vertical scale of the diagrams produced is a scale of torsional moments, and the horizontal scale is one of total angles of torsion. Since the resistance to shearing, in a homogeneous material, varies with the resistance to longitudinal stress, the vertical scale is also for such materials a scale of direct resistance; and with approximately homogeneous substances this scale is approximately accurate, where, as here, all specimens compared are of the same dimensions. 28. By fig. 4 it will be seen that the first portion of the line rises at a slight inclination from the vertical, and very nearly straight. The amount of distortion here is seen to be approximately proportional to the distorting force, illustrating Hooke's law, *Ut tensio sic vis.* After a degree of distortion which is determined by the specific character of each piece, the line becomes curved, the change of form having a rate of increase which varies more rapidly than the applied force. When this change begins, the molecules, which up to that point retain generally their original distribution, while varying their relative distances, begin to change their positions with respect to each other, moving upon each other in a manner similar to that action described by H. Tresca, and called the "flow of solids." This point, at which the line begins to become concave toward the base, is considered as marking the torsional limit of elasticity. It is well defined in experiments upon woods; is less marked, but still well defined, in the fibrous irons and the less homogeneous specimens of other metals; and becomes quite indeterminable with the most homogeneous materials, as with the best qualities of well worked cast steel. This point does not indicate the first set, since a set occurs with every degree of distortion, however small. It is at this elastic limit that the sets begin to become proportional to the degree of distortion. The inclination of the straight portion of the line from the vertical measures the stiffness of the specimen. This rigidity is very closely, if not precisely, proportional to the hardness, in homogeneous substances; and this quantity is taken, for practical purposes, as a measure of the hardness of the metals and of their elastic resistance to compression. After passing the elastic limit, the line becomes more and more nearly parallel to the base line, and then, with the woods invariably, and in some cases with the metals, begins to fall before fracture becomes evident in the specimen. With the more ductile substances, nearly all the particles are brought up to a maximum in resistance before fracture occurs, and this circumstance has an important influence in deter-

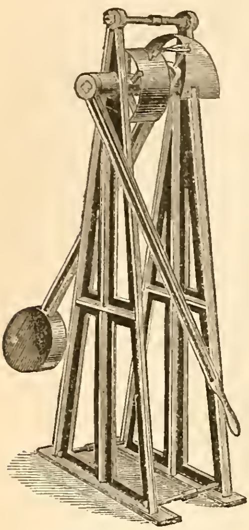


FIG. 2.—Thurston's Testing Machine.

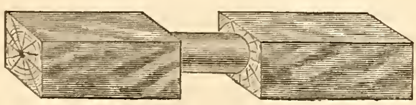


FIG. 3.—Test Piece.

mining the resistance to rupture. The hardest and most brittle materials break with a snap before any flow is perceptible, before the line of the diagram begins to deviate from the direction taken at the commencement, and before the approach to the elastic limit is indicated. The elasticity of the material is determined by relaxing the distorting force, and allowing the specimen to relieve itself from distortion so far as its elasticity will permit. In such cases, the pencil traces a line *e*, O, resembling, in its general form and position in respect to the coördinates, that forming the initial portion of the diagram, but almost absolutely straight, and more nearly vertical. The degree of inclination of this line indicates the elasticity, precisely as the initial straight line gives a measure of the original stiffness of the test piece. The homogeneity of the material tested is hardly less important than its strength. The degree of depression of the line immediately after passing the elastic limit exhibits the greater or less homogeneousness of the material. The resilience of the specimen is measured by the area included within the curve, this being the product of the mean force exerted into the distance through which it acts in producing rupture; *i. e.*, it is proportional to the work done by the test piece in resisting fracture, and, taken up to the ordinate of the limit of elasticity, measures the capacity for resisting shock without serious distortion or injurious set. The ductility of the specimen is deduced from the value of the total angle of torsion, and its measure is the elongation of a line of surface particles, originally parallel to the axis, which line assumes a helical form as the test piece yields, and finally parts at or near the point where the maximum resistance is observed. 29. The strain diagrams exhibit the characteristic differences of various materials. The woods have a structure which differs in a distinguishing degree, both in the distribution of the substance and in the action of those molecular forces capable of resisting rupture, from that of the metals, the latter being far more homogeneous than the former. Wood consists of an aggregation of strong fibres, lying parallel, or approximately so, and held together often by a comparatively feeble force of lateral cohesion. The metals, on the other hand, are naturally homogeneous, both in structure and in the distribution and intensity of the molecular forces. Well worked and thoroughly annealed cast steel, as an example, is equally strong in all directions, is perfectly uniform in its structural character, and is almost absolutely homogeneous as to strain. Wrought iron, as usually made, has a somewhat fibrous structure, which is produced by particles of cinder originally left in the mass by the imperfect work of the puddler while forming the ball of sponge in his furnace, which, not having been removed by the squeezers or by hammering the puddle ball, are, by the process of rolling, drawn out into long lines of non-cohering matter, and produce an effect upon the mass of metal which makes its behavior under stress somewhat similar to that of the stronger and more thready kinds of wood. In the low steels also, in which, in consequence of the deficiency of manganese accompanying almost of necessity their low proportion of carbon, this fibrous structure is produced by cells and bubble holes in the ingot, refusing to weld up in working, and drawing out into long microscopic, or less than microscopic, capillary openings. In consequence of this structure, a depression indicating this heterogeneousness of structure interrupts the regularity of their curves, immediately after passing the limit of elasticity. 30. The presence of internal strain constitutes an essential peculiarity of the metals which distinguishes them from organic materials. The latter are built up by the action of molecular forces, and their particles assume naturally and invariably positions of equilibrium as to strain. The same is true of all naturally formed organic substances. The metals, however, are given form by external and artificially produced forces. Their molecules are compelled to assume certain relative positions, and these positions may be those of equilibrium, or they may be such as to strain the cohesive forces to their very limit. This peculiar condition is of serious importance where the metal is brittle, as is illustrated by the behavior of cast iron, and particularly in ordnance. Even in ductile metals, it produces a reduction in the power of the material to resist external forces. This condition of internal strain may be relieved by annealing hammered and rolled metals, and by cooling castings very slowly, so that the particles may naturally assume positions of equilibrium. In tough and ductile metals, internal strain may be removed by heating to a high temperature and then cooling under the action of a force approximately equal to the elastic resistance of the substance. This process, called "thermo-tension," was first used by Prof. W. R. Johnson in 1836. The cause of this, which he terms an anomalous condition of the metal, was not then discovered. Ductile metals may be strengthened in a considerable degree by this relief of internal strain, and also by simply straining them while cold to the elastic limit, and thus dragging all their particles into extreme positions of tension, from which when released from strain they may all spring back into their natural and unstrained positions of equilibrium. This fact was noted by Prof. Thurston, and soon after independently by Commander Beardslee, U. S. N. It has an important bearing upon the resisting power of materials, and upon the character of all formulas in which it may be attempted to embody accurately the law of resistance of such materials to distorting or breaking strain. The initial portion of the diagram, when the material is free from internal strain, is a straight line up to the limit of elasticity. This line, with strained materials, becomes con-

vex toward the base line. The initial portion of the diagram, therefore, determines whether the material tested has been subjected to internal strain, or whether it is homogeneous as to strain. This is exhibited by the direction of this part of the line, as well as by its form. The existence of internal strain causes a loss of stiffness, which is shown by the deviation of this part of the line from the vertical to a degree which becomes observable by comparing its inclination with that of the line of elastic resistance. 31. In fig. 4, the strain diagram A is that of zinc. The concave form at the commencement indicates its inelastic nature, its slight altitude shows its weakness, and, breaking at 65°, it is shown to lack ductility. Tin, T, is vastly more ductile, but is still less tenacious. B and C are the diagrams given by cast and forged copper, the latter twisting 500°, and its fibres stretching to three times their original length. Cast copper is comparatively weak and brittle. Wrought iron gives the strain diagram D. It indicates the elasticity of the metal, its ductility, and its strength. The elastic limit is plainly indicated. The con-

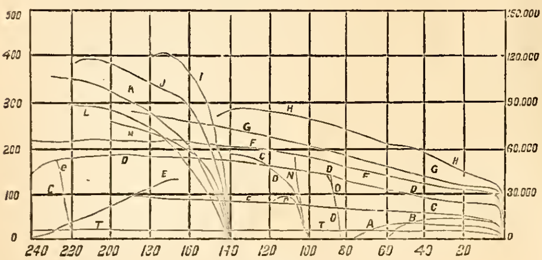



Fig. 4.—Strain Diagrams.

cavity of the initial portion of the line indicates some internal strain, and the horizontal portion immediately above the elastic limit shows that the metal was "seamy" and not perfectly homogeneous. The lines $e$ and O are "elasticity lines." They differ slightly in direction from the initial portion of the diagram, confirming the previously indicated presence of internal strain. E is the terminal portion of the diagram of a soft ductile iron. F is that given by a very strong and ductile and exceptionally homogeneous iron, a very smooth and symmetrical curve. G is a soft Bessemer steel. H is somewhat harder, the one containing 0·4 and the other 0·5 per cent. of carbon. I and J are tool steels containing 1 per cent. of carbon. K is medium, L spring, and M double shear steel. N and P are obtained from white and gray cast iron. One is stiff, hard, and brittle, the other weaker, soft, and comparatively tough. O is a malleableized cast iron made from N; it has lost no strength, and has gained considerable ductility. Strain diagrams may be produced by plotting data obtained by observation in the usual manner and similarly interpreted. 32. An examination of the fracture in each case assists in determining the character of the material, and in interpreting the strain diagram. The following figures exhibit the characteristics of various qualities of iron and steel. Fig. 5 resembles that which gave the diagram marked D. The metal is good and tough, but seamy, and not thoroughly worked, as is shown by the cracks extending around the neck and by the irregularly distributed flaws on its end. Fig. 6 exhibits the appearance of the sample F. The surface of the

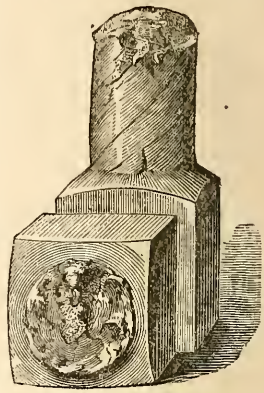


Fig. 5.

neck was originally smoothly turned, polished, and fitted to gauge. Under test it became curiously altered and assumed a rough, striated appearance. The end has the peculiar appearance characteristic of tough and ductile metals, and the uniformly bright appearance of the fractured section shows that all held together up to the instant of rupture, and that fracture finally took place by shearing. Fig. 7 represents the appearance of low steels. The peculiarities of the finest tool steels are exhibited in fig. 8. In this the fracture is ragged and splintery, and the separated surfaces have a beautifully fine, even grain, which proves the excellence of the material. The surface, which was turned and polished in bringing the metal

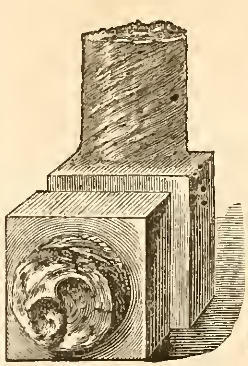


Fig. 6.

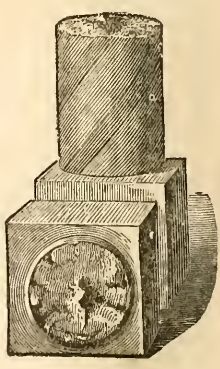


Fig. 7.

to size, remains as perfect as before the specimen was broken. By an inspection of the broken test pieces in this manner, the grade of the steel, and by the practised eye the slightest

TABLE OF COEFFICIENTS OF RESISTANCE.

| MATERIAL. | W. Weight per cubic foot. | T. Tension. | C. Crushing. | K. Transverse. | S. Torsion. | E. Coefficient of elasticity. | R. Resilience. |
|---|---|---|---|---|---|---|---|
| METALS. | | | | | | | |
| Antimony | 280 | 1,000 | ...... | ..... | 15 | ........ | ...... |
| Bismuth | 613 | 3,000 | ...... | ..... | 50 | ........ | ...... |
| Brass: | | | | | | | |
| Copper 10, zinc 1 | 535 | 22,000 | 50,000 | ..... | 200 | 8,000,000 | 6,000 |
| " 6, " 1 | 525 | 30,000 | 160,000 | 240 | 500 | 9,000,000 | 8,000 |
| " 3, " 1 | 525 | 28,000 | ...... | ..... | ..... | 8,000,000 | 4,000 |
| Fine drawn | 535 | 80,000 | 165,000 | ..... | 1,000 | 14,000,000 | 15,000 |
| Bronze: | | | | | | | |
| Aluminum 10, copper 90 | 480 | 70,000 | 135,000 | ..... | 400 | 10,000,000 | ...... |
| Copper 10, tin 1 | 535 | 36,000 | ...... | ..... | 500 | 11,000,000 | 8,000 |
| " 8, " 1 | 528 | 40,000 | ...... | ..... | 700 | 12,000,000 | 6,000 |
| " 6, " 1 | 540 | 40,000 | ...... | ..... | ..... | ........ | 2,000 |
| Copper: | | | | | | | |
| Cast | 540 | 20,000 | ...... | ..... | 350 | 3,000,000 | 200 |
| Rolled | 550 | 30,000 | 100,000 | ..... | 400 | ........ | ...... |
| Drawn | 555 | 60,000 | 100,000 | ..... | 750 | ........ | ...... |
| Forged | 552 | 40,000 | 100,000 | 220 | 600 | 3,750,000 | 40,240 |
| Gold wire | 1,210 | 20,000 | 85,000 | ..... | ..... | ........ | ...... |
| Iron: | | | | | | | |
| Cast, pig | 440 | 20,000 | 100,000 | 500 | 400 | 13,000,000 | 15 |
| " hard | 450 | 30,000 | 125,000 | 700 | 600 | 22,000,000 | 5 |
| " tough | 450 | 25,000 | 120,000 | 600 | 500 | 15,000,000 | 25 |
| " gun iron | 455 | 30,000 | 125,000 | 700 | 700 | 25,000,000 | 50 |
| Wrought, bar | 486 | 60,000 | 50,000 | 900 | 750 | 22,000,000 | 20,000 |
| " sheet | 480 | 50,000 | 60,000 | 700 | 650 | 25,000,000 | 15,000 |
| " tank | 480 | 45,000 | 65,000 | 500 | 600 | 25,000,000 | 10,000 |
| " wire ⅛ inch | 485 | 80,000 | 60,000 | 900 | 1,000 | 28,000,000 | 40,000 |
| " large forging | 475 | 40,000 | 40,000 | 500 | 500 | 20,000,000 | 10,000 |
| Lead, cast | 710 | 1,800 | 7,000 | 20 | 20 | 1,000,000 | ...... |
| " rolled | 712 | 2,500 | ...... | 30 | 30 | ........ | ...... |
| Platinum | 1,340 | 55,000 | ...... | 700 | ..... | ........ | ...... |
| Silver | 654 | 40,000 | ...... | 500 | ..... | ........ | ...... |
| Steel: | | | | | | | |
| Carbon 0·0033 | 488 | 65,000 | 80,000 | 800 | 900 | 25,000,000 | 35,000 |
| " 0·0050 | 487 | 90,000 | 125,000 | 1,500 | 1,200 | 27,000,000 | 15,000 |
| " 0·0075 | 486 | 100,000 | 150,000 | 2,000 | 1,350 | 29,000,000 | 10,000 |
| " 0·0100 | 485 | 140,000 | 225,000 | 3,000 | 1,800 | 30,000,000 | 10,000 |
| " 0·0125 | 485 | 160,000 | 250,000 | 5,000 | 2,000 | 31,000,000 | 5,000 |
| Hardened in oil | .... | 200,000 | 350,000 | 7,000 | 3,000 | 38,000,000 | ...... |
| Rails | 488 | 70,000 | 100,000 | 900 | 900 | ........ | 30,000 |
| Plate | 487 | 80,000 | 120,000 | 1,200 | 1,100 | ........ | ...... |
| Blister | 488 | 100,000 | 150,000 | 2,000 | 1,500 | ........ | ...... |
| Shear | 486 | 120,000 | 180,000 | 2,500 | 2,000 | ........ | 5,000 |
| Tin, block | 455 | 4,000 | 15,500 | 50 | 60 | 4,500,000 | 2,500 |
| " wire | 460 | 7,000 | ...... | 80 | 90 | ........ | ...... |
| Zinc, cast | 437 | 2,500 | ...... | 30 | 30 | 13,000,000 | 500 |
| " rolled | 440 | 15,000 | ...... | 200 | 200 | ........ | ...... |
| MINERALS. | | | | | | | |
| Brick, red | 130 | 150 | 1,000 | 5 | ..... | ........ | ...... |
| " " | 135 | 300 | 2,000 | 10 | 14 | ........ | ...... |
| Cement, 1 week | 120 | 100 | ...... | 20 | ..... | ........ | ...... |
| " 1 year | 120 | 400 | 2,000 | 5 | 69 | ........ | ...... |
| Chalk | 117 | ...... | 334 | ..... | ..... | ........ | ...... |
| Glass, plate | 153 | 9,420 | ...... | ..... | ..... | ........ | ...... |
| Granite | 165 | 1,000 | 10,000 | 25 | 980 | ........ | ...... |
| Limestone | 165 | 500 | 6,000 | 40 | 100 | 25,000,000 | ...... |
| Marble | 165 | ...... | 9,000 | 40 | ..... | 25,000,000 | ...... |
| Sandstone | 150 | 200 | 5,000 | 15 | 300 | ........ | ...... |
| Mortar | 107 | 50 | 180 | ..... | ..... | ........ | ...... |
| TIMBER. | | | | | | | |
| Acacia | 47 | 16,000 | ...... | 140 | ..... | 1,152,000 | ...... |
| Apple tree | 50 | 19,000 | ...... | ..... | ..... | ........ | ...... |
| Ash | 45 | 16,000 | 9,000 | 150 | 120 | 1,500,000 | ...... |
| Beech | 50 | 16,000 | 8,000 | 120 | 110 | 1,400,000 | ...... |
| Birch | 50 | 15,000 | 5,000 | 130 | ..... | 1,500,000 | ...... |
| Box | 60 | 18,000 | 10,000 | 130 | 125 | ........ | ...... |
| Cedar | 55 | 11,500 | 6,000 | 100 | 100 | ........ | ...... |
| Elm | 37 | 13,000 | 10,000 | 75 | ..... | 700,000 | ...... |
| Fir, N. E | 35 | 12,000 | 6,000 | 80 | 75 | 2,000,000 | ...... |
| Larch | 35 | 9,000 | 10,000 | 100 | 80 | 1,000,000 | ...... |
| Lancewood | 60 | 23,000 | ...... | 150 | 120 | ........ | ...... |
| Lignumvitæ | 75 | 12,000 | 10,000 | 160 | 150 | ........ | ...... |
| Locust | 60 | 20,000 | ...... | 250 | 220 | ........ | ...... |
| Mahogany | 50 | 16,000 | 8,000 | 120 | 180 | ........ | ...... |
| Maple | 50 | 10,000 | ...... | ..... | ..... | ........ | ...... |
| Oak | 55 | 17,000 | 10,000 | 150 | 140 | 1,500,000 | ...... |
| Pine | 40 | 10,000 | 8,000 | 100 | 65 | 1,750,000 | ...... |
| Spruce | 30 | 17,000 | 6,000 | 120 | ..... | 1,600,000 | ...... |
| Teak | 45 | 15,000 | 12,000 | 180 | 150 | 2,400,000 | ...... |
| Walnut, white | 42 | 8,000 | 7,000 | 100 | 200 | ........ | ...... |
| " black | 40 | 8,000 | 8,000 | 150 | 130 | ........ | ...... |

possible variations, are readily distinguished. Fig. 9 is white cast iron. Its surface, where fractured, has the general appearance of broken tool steel, but the color and texture of the metal are distinctive; it has none of the "steely grain." Fig. 10 represents dark foundery iron.

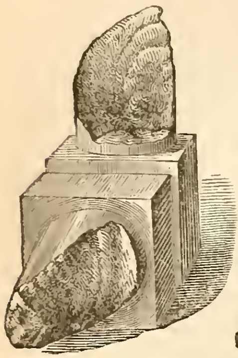


Fig. 8.

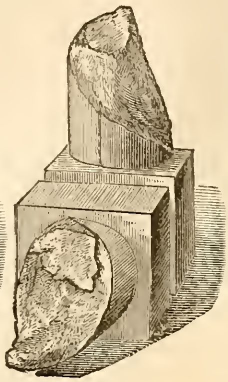


Fig. 9.

Its color, its granular structure, and coarse grain are markedly characteristic. 33. Good iron plates should, in addition to the above tests, be subjected to the following: When red-hot, they should be capable of being bent sharply to a right angle without cracking, up to an inch in thickness. Ordinary boiler plate of good quality should bend double. When cold, they should bend along the grain without cracking, as follows: 1 in. thick, 15°; ¾ in. thick, 25°; ½ in. thick, 35°; ¼ in. thick, 90°. Across the grain they should at least bend half as far. They should be bent on a slab rounded on the corners with a radius of ½ in. Steel plates should be 50 per cent. more ductile.

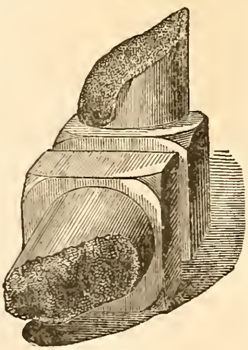


Fig. 10.

34. *Testing within the Limit of Elasticity.* In determining the value of materials of construction, it is usually more necessary to determine the position of the limit of elasticity, and the behavior of the metal within that limit, than to ascertain ultimate strength or resilience. It should be possible to test every piece of material which goes into an important structure, and then to use it with confidence that it has been proved capable of carrying its load with a sufficient and known margin of safety. It is common to test bridge rods to a limit of strain determined by specification, and to compel their rejection when they are found to take a considerable permanent set under that strain. Specification now frequently (and it should invariably) makes the limit of elasticity the basis of calculation and test.—See Fairbairn, "Cast and Wrought Iron" (London, 1865); Haswell, "Engineers' and Mechanics' Pocket Book" (New York, 1868); Trautwine, "Civil Engineers' Pocket Book" (Philadelphia, 1872); Rankine, "Useful Rules and Tables" (London, 1872); Thurston, "Strength, Elasticity, Ductility, and Resilience of Materials of Construction" (Philadelphia, 1874); and Wood, "Resistance of Materials" (New York, 1875).

**STRICKLAND, Agnes,** an English authoress, born at Reydon hall, Suffolk, July 19, 1796, died in London, July 13, 1874. She was carefully educated under the personal supervision of her father. Her works are: "Worcester Field, or the Cavalier," a poem (1812); "Demetrius," a poetical romance (1833); "The Pilgrims of Walsingham," a series of tales (1835); "Alda, the British Captive" (1841); with her sister Elizabeth, "Lives of the Queens of England" (12 vols., 1840–'49; abridged and edited by Caroline G. Parker, 1 vol. 12mo, New York, 1867), and "Lives of the Queens of Scotland" (8 vols., 1850–'59); "Queen Victoria, from her Birth to her Bridal" (2 vols., 1840); "Historic Scenes and Poetic Fancies" (1850); "Old Friends and New Acquaintances" (1850); "Lives of the Bachelor Kings of England" (1861); "How will it End?" a novel (1865); "Lives of the Seven Bishops committed to the Tower in 1688" (1866); and "Lives of the Tudor Princesses" (1868). She edited an edition of the letters of Mary, queen of Scots, and thus brought to public notice many documents of much historic value. In 1871 she received an annual pension of £100. —The sisters of Miss Strickland, Jane Margaret, Catharine Parr (Mrs. Trail), and Susannah (Mrs. Moodie), besides assisting her in her historical works, published several books under their own names. Mrs. Trail and Mrs. Moodie are residents of Canada, and their chief works have been upon life in that country.

**STRICKLAND, William Peter,** an American clergyman, born in Pittsburgh, Pa., Aug. 17, 1809. He was educated at the Ohio university, Athens, O., entered the ministry of the Methodist Episcopal church in 1832, labored several years in Cincinnati, and then became agent of the American Bible society. In 1850 the Ohio university conferred on him the degree of D. D. In 1856 he removed to New York, where he engaged in literary labor, mostly in connection with the Methodist book concern. In 1862 he was chaplain of the 48th New York regiment, stationed at Port Royal, S. C. Since 1866 he has been pastor of the Presbyterian church in Bridgehampton, L. I. His principal publications are: "History of the American Bible Society" (New York, 1849; new ed., with history continued, 1856); "History of Methodist Missions" (1850); "Genius and Mission of Methodism" (1851);

"Christianity Demonstrated" (1852); "Memoir of the Rev. James B. Finley" (1853); "A Manual of Biblical Literature" (1853); "The Light of the Temple" (Cincinnati, 1854); "The Astrologer of Chaldea" (1856); "Pioneers of the West" (New York, 1856); "Life of the Rev. Francis Asbury" (1858); "Life of Jacob Gruber" (1859); and "Old Mackinaw" (Philadelphia, 1860).

**STRINGHAM, Silas Horton**, an American naval officer, born at Middletown, N. Y., Nov. 7, 1798, died in Brooklyn, Feb. 7, 1876. He entered the navy as midshipman in 1809, became lieutenant in 1814, and served in Decatur's squadron in the Algerine war. Subsequently he assisted in the capture of slavers off the coast of Africa. In command of the Ohio in 1846 he took part in the bombardment of Vera Cruz. He was in constant service on sea or shore duty till 1861, when he became flag officer of the Atlantic blockading squadron, and in August coöperated in the capture of Forts Hatteras and Clark on the coast of North Carolina. He was promoted to rear admiral on the retired list in 1862, was commandant of the Charleston navy yard in 1864–'6, and was made port admiral of New York in 1867.

**STRISORES**, a suborder of insessorial or perching birds, without song, comprising such as have the hind toe capable of being turned more or less laterally forward, having apparently all four of the toes in front. It includes the families of the humming birds, swifts, and goatsuckers. (See ORNITHOLOGY.)

**STRONG, Caleb**, an American statesman, born in Northampton, Mass., Jan. 9, 1745, died there, Nov. 7, 1819. He graduated at Harvard college in 1764, and was admitted to the bar in 1772. During the revolution he was a member of the general court and of the Northampton committee of safety. He held several state offices, was a member of the convention for framing a national constitution, was elected one of the first United States senators from Massachusetts in 1789, was reëlected in 1793, and resigned in 1796. From 1800 to 1807 he was governor of Massachusetts, and again from 1812 to 1816. As a federalist he was opposed to the war with England, and believed himself justified on constitutional grounds in disregarding the president's requisition for troops, while amply providing for the defence of the state. (See MILITIA, vol. xi., p. 541.)

**STRONG, James**, an American author, born in New York, Aug. 14, 1822. He graduated at Wesleyan university, Middletown, Conn., in 1844, and in 1844–'6 was a teacher in the Troy conference academy, Poultney, Vt. In 1847 he settled at Flushing, Long Island, where he held several local offices, projected and as president constructed the Flushing railroad, laid out a cemetery and two suburban villages, and taught Greek and Hebrew to private pupils. In 1856, although a layman, he received the degree of S. T. D. from Wesleyan university. In 1858–'61 he was professor of Biblical literature and acting president of the Troy university; and in 1868 he became professor of exegetical theology in Drew theological seminary, Madison, N. J. In 1874 he made an extended tour in the East. He is a member of the Anglo-American commission for the revision of the authorized English Bible, and of the Palestine exploration society, and president of the oriental topographical corps. His chief literary work is the "Cyclopædia of Biblical, Theological, and Ecclesiastical Literature," projected by him and Dr. John McClintock in 1853, in which he had charge of the department of Biblical literature, and Dr. McClintock, to the time of his death in 1870, of theological and ecclesiastical literature. Since that date Dr. Strong has been supervising editor of the whole work, assisted by Prof. J. H. Worman. The first volume appeared in 1867, and the sixth in 1875; and it is to be completed in ten volumes. Dr. Strong has also published "Harmony and Exposition of the Gospels" (New York, 1852); "Greek Harmony of the Gospels" (1854); brief manuals of Greek and Hebrew grammar; and articles on Biblical topics and on ministerial education, the latter eliciting much controversy; and he prepared the part on Daniel for the English translation of Lange's "Commentary" (New York, 1875).

**STRONTIUM**, one of the three metals of the alkaline earths, barium and calcium being the other two. It was first obtained from the native carbonate of strontium by Sir Humphry Davy in 1808, in a manner similar to that for barium. The pure metal may be more readily obtained from the fused chloride by electrolysis according to the method of Matthiessen. A small porcelain crucible, having a porous cell in the middle, is filled with anhydrous chloride of strontium mixed with a little sal ammoniac. The negative electrode, consisting of a thin iron wire wound round a thicker one, and all but about $\frac{1}{16}$ of an inch covered with a piece of tobacco-pipe stem, is placed in the porous cell. The positive electrode, in the form of an iron cylinder, is placed in the crucible round the porous cell. The heat is so regulated that a crust shall form in the cell, under which the metal collects during the passage of the galvanic current. The pure metal has a pale yellow color and a specific gravity of 2·54. Its symbol is Sr; its atomic weight, 87·6. When heated in the air it burns with a crimson flame, emitting sparks, and decomposes water with evolution of hydrogen gas. It is about as hard as gold, very ductile, and may be hammered into very thin plates. With oxygen it forms two anhydrous oxides: strontium monoxide, $SrO$, and strontium dioxide, $SrO_2$, each of which unites with water to form a hydrate. The oxide, called strontia, has the same relation to the metal that lime has to calcium; and, like lime, one of its most important compounds is the carbonate, or strontianite, which was discovered in 1787 at Strontian in Argyleshire, Scotland, whence the

name. The mineral was then regarded as a carbonate of barium, but Crawfurd's supposition that it contained a peculiar earth was confirmed by Hope in 1792, and by Klaproth in 1793.—*Principal Salts.* The chloride ($SrCl_2$), the iodide ($SrI_2$), and the bromide ($SrBr_2$) are all easily soluble in water and decomposable by heat. The nitrate ($Sr2NO_3$) is extensively used in producing the crimson lights of fireworks. A mixture of 40 parts of strontium nitrate with from 5 to 10 parts of potassic chlorate, 12 of sulphur, and 4 of antimonious sulphide, deflagrates with a magnificent crimson color. Its preparation is dangerous, in consequence of its liability to ignite spontaneously. Nitrate of strontia may be prepared by treating the native carbonate with dilute nitric acid, but it is more usual to employ the native sulphate, which is reduced to a sulphide by heating it with charcoal, and then subjected to the action of dilute nitric acid. It crystallizes from hot, concentrated solutions in anhydrous octahedrons, which are insoluble in alcohol, but soluble in half their weight of boiling water and in five parts of cold water. From the cold solution it may be obtained in monoclinic crystals, having four molecules of water. Sulphate of strontium ($SrSO_4$) is found native as the mineral celestine, so named from its occasional delicate blue color, although it occurs white, gray, yellow, and red. It may also be prepared by the action of sulphuric acid on strontianite, or of a soluble strontia salt, as the nitrate, on another metallic sulphate. Its crystals are modifications of the right rhombic prism, being isomorphous with the sulphates of barium and calcium. The mineral is usually associated with limestone, or sandstone of the Silurian, Devonian, and other formations. It is also found in beds of gypsum, rock salt, and clay, and sometimes in trap rocks, and with volcanic sulphur. Splendid crystals are found at Girgenti, Sicily, associated with sulphur and gypsum. It is found at Bex in Switzerland, at Dornburg in Saxe-Weimar, in Tyrol, in rock salt at Ischl in Austria, and in trap rocks near Tantallan in East Lothian, Scotland. Beautiful bluish crystals occur in Trenton limestone about Lake Huron, particularly on Strontian island, and at Kingston, Canada. Fine specimens have been found at Schoharie and at Lockport, N. Y. A blue, fibrous celestine is found near Frankstown, Huntingdon co., Pa.; on Drummond island, Lake Erie, it occurs mixed with barium.

**STROSSMAYER, Joseph George,** a Croato-Slavonian prelate, born in Eszék, Feb. 4, 1815. He was educated at Pesth, Vienna, and Padua, and became bishop of the united sees of Bosnia and Sirmia, May 20, 1850. At the Vatican council he strenuously maintained the inopportuneness of defining the doctrine of pontifical infallibility. He was represented as having delivered a violent opposition speech in one of the sessions, the text of which was reproduced by several journals; but in 1872 he addressed a letter to the *Français* denying the authenticity of this speech, and affirming that he "never said one word during the entire council which could in any way diminish the authority of the holy see, or tend to promote discord in the church." He is known as a zealous champion of Slavic autonomy, and a munificent promoter of Slavic culture. In 1875 he published a pastoral letter on the occasion of his 25th anniversary as bishop, declining a public manifestation in his honor, "while the fellow countrymen of the Croats across the frontier are shedding their blood for liberty, and Christian charity makes it a duty to aid the widows and orphans of the fallen."

**STROTHER, David Hunter,** an American artist, born in Martinsburg, Va., Sept. 26, 1816. He studied drawing and painting, in 1845 went to New York, learned to draw on wood and illustrated some books, and in 1849 returned to Virginia. From 1853 till 1861 he published, under the pseudonyme of Porte Crayon, a series of illustrated papers, mostly relating to Virginia and the south, some of which were collected in his "Virginia Illustrated" (New York and London, 1857). On the outbreak of the civil war he volunteered in the United States service, was a colonel of cavalry, and at the close retired as a brevet brigadier general. Since 1866 he has resided at Berkeley Springs, W. Va., and continues his illustrated papers on southern subjects.

**STROUSBERG, Bethel Henry,** known as doctor, a German adventurer, born of Jewish parents at Neidenburg, East Prussia, Nov. 20, 1823. His original name was Baruch Hirsch Strausberg. In 1835 he entered the commission house of his uncles in London, became a Christian, and married an English woman. He finally engaged in the insurance business, incurred losses in 1847, taught languages at New Orleans in 1848, returned in 1849 to London with money made by trading in damaged goods, and was interested in publishing "The Chess Player," "Lawson's Merchant's Magazine," and "Sharpe's London Magazine." In 1855 he settled in Berlin as agent for an insurance company, and in 1861 obtained for English capitalists the concession of an East Prussian railway. After building other railways for different companies, he built many on his own account, chiefly in northern Germany, Hungary, and Roumania, and became the owner of vast establishments for producing all the materials required for them, as well as of beet-sugar, porcelain, and other factories, mines, the Berlin cattle yard, the Antwerp south citadel grounds, and the great Zbirow domain in Bohemia. At one time he employed more than 100,000 persons, and was engaged in speculations involving several hundred millions of dollars. He eclipsed princes in his luxurious living and ostentatious charities, and was popularly known in Berlin as

*Der Wunderdoctor.* He lost heavily during the war of 1870-'71, became inextricably involved in 1872 after a ruinous settlement with the Roumanian government on account of unfulfilled railway contracts, failed in 1875, and in November was imprisoned at Moscow for alleged fraudulent transactions with a bank.

**STRUENSEE, Johann Friedrich,** count, a Danish statesman, born in Halle, Aug. 5, 1737, executed at Copenhagen, April 28, 1772. He became in 1768 the physician and favorite of King Christian VII., and subsequently of his queen, Carolina Matilda. The king gave himself up to vicious indulgence, while the queen dowager led by Count Bernstorff, and the party of the queen led by Struensee, strove for power. The latter triumphed, and Struensee was appointed prime minister. After instituting important reforms, he became obnoxious on account of his arbitrary measures and his alleged illicit relations with the queen, and his enemies finally procured his ruin. (See CHRISTIAN VII., and CAROLINA MATILDA.)

**STRUTT, Joseph,** an English antiquary, born in Springfield, Essex, Oct. 27, 1742, died in London, Oct. 16, 1802. He studied painting and engraving, afterward engaged in antiquarian researches in the British museum, and published "The Regal and Ecclesiastical Antiquities of England, containing the most authentic Representations of the English Monarchs from Edward the Confessor to Henry VIII." (4to, 1773; new ed. by J. R. Planché, 1842); "Horda-Angel-Cynnan, or a Complete View of the Manners, Customs, Arms, Habits, &c., of the Inhabitants of England from the arrival of the Saxons till the Reign of Henry VIII." (3 vols. 4to, 1774-'6); "The Chronicle of England" (2 vols. 4to, 1777-'8), intended to comprise 6 vols., but terminated with the Norman conquest; "Biographical Dictionary of Engravers" (2 vols. 4to, 1785-'6); "Complete View of the Dress and Habits of the People of England, from the Establishment of the Saxons in Britain to the present Time" (2 vols., 1796-'9; new ed., 1875); and "The Sports and Pastimes of the People of England" (4to, 1801), well known by Hone's edition (8vo, 1830; latest ed., illustrated, 1875). He left a fragment of a romance entitled "Queen Hoo Hall," edited by Sir Walter Scott (1808), and other writings published posthumously. Strutt engraved a series of plates illustrating the "Pilgrim's Progress."

**STRUVE. I. Friedrich Georg Wilhelm von,** a Russian astronomer, born in Altona, April 15, 1793, died in St. Petersburg, Nov. 23, 1864. He was educated at Dorpat, and in November, 1813, was appointed extraordinary professor of mathematics and astronomy there, two years later becoming ordinary professor. His duty in that office was not only to attend to the observatory, but also to lecture on astronomy and mathematics; but in 1822 the two offices were separated, and Struve was henceforth free to work exclusively as an astronomer. In 1839 he was made director of the observatory of Pulkova, which had been built under his direction, and not long after he was made councillor of state. He confined his labors as an astronomer principally to the observation of fixed and double stars, and made large additions to the knowledge of these bodies. He also conducted the triangulation of Livonia, and measured the degrees of latitude in the Baltic provinces, and an arc of the meridian between Norway and southern Russia. In 1857 Struve visited England to organize and arrange the measurement of an arc of parallel through the entire breadth of Europe, from Orsk at the foot of the Ural mountains to Valentia at the western extremity of Ireland. This work he fairly initiated, but in 1858 he was attacked by a malady which prevented him from coöperating further in it save by advice and calculation; and in December, 1861, he was compelled to resign his active duties as director of the observatory. His most important works are: *Observationes Dorpatenses* (8 vols., Dorpat, 1817-'39); *Catalogus Novus Stellarum Duplicium* (1827); *Stellarum Duplicium Mensuræ Micrometricæ* (St. Petersburg, 1827); *Description de l'observatoire astronomique central de Russie* (1845, with 36 plates); *Études d'astronomie stellaire sur la voie lactée et la distance des étoiles fixes* (1847); and *Stellarum Fixarum imprimis Duplicium et Multiplicium Positiones Mediæ pro Epocha* 1830, &c. (fol., 1852).—See a memoir by Prof. Cleveland Abbe, in the appendix to the report for 1869 of the secretary of the Smithsonian institution. **II. Otto Wilhelm,** son of the preceding, born at Dorpat, May 7, 1819. He became his father's assistant at Pulkova in 1839, and succeeded him as director in 1862. From 1847 to 1862, as consulting astronomer, he had the oversight of all investigations conducted by the Russian army and navy. His labors relate chiefly to nebulæ, double stars, faint satellites, and comets, and include a new determination of the constant of precession, the discovery of about 500 new double stars, most of them barely separable, the determination of the mass of Neptune, investigations in regard to Saturn and his rings and to the parallax of various fixed stars, and observations of the nebula of Orion. He first showed that the red prominences visible in a total solar eclipse belong to the sun's surface. Besides numerous papers in the *Mémoires* of the academy of St. Petersburg, he has published *Uebersicht der Thätigkeit der Nikolai-Hauptsternwarte während der ersten 25 Jahre ihres Bestehens* (St. Petersburg, 1865).

**STRUVE. I. Georg Adam,** a German jurist, born in Magdeburg, Sept. 26, 1619, died in Jena, Dec. 15, 1692. He studied law at Jena and Helmstedt, and in 1646 was appointed professor of law at Jena, and in 1648 assessor to the high court of the circle of Saxony. In 1667 he was appointed privy councillor to the duke of Weimar, and was selected as his advocate in the case of the succession to the

duchy of Saxe-Altenburg. In 1674 he returned to Jena as professor of canon law and *ordinarius* of the judicial college, and in 1680 was appointed president of the regency of Weimar, the duke being a minor. He published 13 elaborate treatises on law, of which the most important are: *Syntagma Juris Feudalis* (Jena, 1653); *Syntagmata Jurisprudentiæ Civilis* (1665); and *Jurisprudentia Romano-Germanica Forensis* (1670). **II. Burkhard Gotthelf,** a German jurist, son of the preceding, born in Weimar, May 26, 1671, died in Jena, May 24, 1738. He studied at Jena and various other German and Dutch universities, and in 1692 engaged at Jena with his brother in the pursuit of the philosopher's stone, in which they soon beggared themselves. In 1704 he became professor of history, and in 1712 extraordinary professor of law. The most important of his numerous works is his *Corpus Juris Gentium* (Jena, 1743).

**STRYCHNIA,** or **Strychnine,** a poisonous vegetable alkaloid, discovered in 1818 by Pelletier and Caventou in the seed of the *strychnos multiflora* or St. Ignatius' bean, and the *strychnos nux-vomica*. (See Nux Vomica.) It is associated with brucia, an alkaloid having similar poisonous properties, but of much less strength. (See Brucia.) Strychnia is also said to be contained in larger proportions in the seeds of the *strychnos tieuté*, a native of Java, from which the poison called upas tieuté is extracted. In preparing strychnia, the seeds of the plant may be first softened by steam and sliced, dried, and ground, or they may be reduced to a pulp by beating. The following is Merck's process for extracting the alkaloid: The seeds are boiled for 24 or 36 hours in a closed boiler with water enough to cover them, acidulated with one eighth of its weight of sulphuric acid. They are then beaten into a paste, and the liquor is expressed. Excess of caustic lime is added, which throws down the alkaloids. The precipitate is then boiled in alcohol of specific gravity 0·850, and filtered hot. Strychnia and brucia are deposited together in a colored and impure state, and may be separated by cold alcohol, which dissolves the brucia. The remaining strychnia is then boiled in alcohol with a little animal charcoal, and the solution filtered boiling hot. On cooling, the strychnia crystallizes in small brilliant, colorless, octahedral crystals, soluble in about 7,000 parts of cold and 2,500 parts of boiling water.—Strychnia is inodorous, but has an exceedingly bitter taste, which is perceptible when the drug is dissolved in 1,000,000 parts of water. It is one of the most active and powerful poisons. The symptoms it produces are difficulty of breathing and a sense of suffocation, twitching of the limbs and tetanic convulsions, the body becoming arched in the back, often resting on the head and heels, a condition known as *opisthotonos*. The features are convulsed, attended by spasm of the jaws and choking. The attack occurs in paroxysms, between which the intellect is often clear at first, but becomes clouded after a succession of paroxysms. The medical properties of strychnia are like those of nux vomica, which was employed by the Arabian physicians. In small doses it acts as a tonic, and it is often given as an adjunct to laxative pills, particularly to dinner pills, in debilitated conditions of the muscular coat of the intestines. When given in larger doses its action is directed to the motor nerves, probably through the medium of the spinal marrow. It produces trembling in the limbs, and a tendency to involuntary muscular contraction, as in tetanus, and frequent starts and spasms occur as from electric shocks, which are increased in intensity by a perseverance in the medicine. It sometimes produces pain in the head, vertigo, contracted pupils, and dimness of vision. The pulse is not particularly affected, though sometimes slightly accelerated. It has been employed on the continent of Europe as an antidote to the plague, in intermittent fevers, and as a remedy in mania, hysteria, rheumatism, and hydrophobia. It is said to have cured spasmodic asthma. Its peculiar influence upon the nerves of motion, to which attention was first called by Magendie, caused M. Fouquier, a French physician, to use it in paralytic affections, and it is now considered a standard remedy in palsy. It is a singular fact that its action is directed first to the muscles of the paralytic part. Its action varies in degree with different animals, being particularly marked upon the canine race. Pelletier and Caventou killed a dog in half a minute with one sixth of a grain. One grain might prove fatal in the human subject; indeed, half a grain proved fatal in the case of Dr. Warner. One twelfth of a grain every four hours, repeated several times, will cause decidedly unpleasant symptoms; but a great difference in its effects is observed in different individuals, some being affected by the administration of one thirtieth of a grain two or three times repeated, while others have been said to take more than a grain at a time, and as much as three grains in the course of 24 hours.—Many antidotes have been proposed. According to M. Duclos, its poisonous effects subside under the application of negative electricity, while they are aggravated by positive. Kermes mineral has been recommended by M. Thorel, being thought by him to form an insoluble sulphuret, and he recommends the administration at the same time of an emetic. Tannic acid, chlorine, and tinctures of iodine and bromine are regarded as the best antidotes by Prof. Bellini. The indications are to evacuate the stomach as quickly as possible, and for this the stomach pump is the most efficient means. In its absence sulphate of zinc or powdered mustard may be used. To relieve the spasms various narcotics have been used, as conium, opium, and *cannabis Indica*, and the reports of their effect are in some

cases decidedly favorable. Chloroform is said to have been used with good effects.

**STRYMON.** See Macedonia.

**STRYPE, John,** an English clergyman, born in London, Nov. 12, 1643, died Dec. 13, 1737. He was educated at St. Paul's school and at Cambridge, and from 1669 till about 1732 he was minister of Low Leyton in Essex. His works include "Memorials of the most renowned Father in God, Thomas Cranmer, sometime Lord Archbishop of Canterbury" (fol., 1694); "The Life of the Learned Sir Thomas Smith" (8vo, 1698); "Historical Collections relating to the Life and Acts of Bishop Aylmer" (8vo, 1701); "Annals of the Reformation" (4 vols. fol., 1709–'31); and "Ecclesiastical Memoirs" (3 vols. fol., 1721). He published an edition of Stow's "Survey of London" (2 vols. fol., 1720), with important additions of his own. His works have been reprinted at Oxford (29 vols. 8vo, 1822–'8).

**STUART,** or **Stewart,** the name of a royal family of Scotland and England. According to tradition, Fleanchus, son of Banquo, on the murder of his father by Macbeth, fled into Wales in 1055, where he married a daughter of a chief named Griffithar Llewellyn; the son of Fleanchus, Walter I. (died 1113), returned to Scotland, and became steward of the household of Malcolm III., which office was made hereditary in his family, and from which the surname Stewart was derived. Walter was succeeded by his son Alan, he by another Walter, and the latter by Alexander, who in 1199 was slain in a battle with the Danes, and left his office to his son Walter III., who conspired against King Alexander II., and was subsequently poisoned by his wife Alda of Dembe. Walter's son and successor Alexander was regent during the minority of Alexander III. His son James was regent after the death of that king, and died in 1309. Walter IV., who succeeded his father, married Marjory, daughter of Robert Bruce, in 1315, upon whom, in failure of the birth of an heir male to her father, the crown was settled by act of parliament at Ayr, April 26, 1315. Marjory died in giving birth to Robert, afterward Robert II. of Scotland; but David II., son of Robert Bruce by a second marriage, came to the throne in 1331 as a minor. A succession of regencies followed, in which Robert the Stewart and the earl of Murray were distinguished, the former at intervals till 1357, when David, captured by the English in 1346, was released and resumed his throne. On the death of David, Robert was unanimously declared king with the title of Robert II. (February, 1371). His licentiousness, and the questioned legitimacy of his first wife's children, with chronic war against England, rendered his reign and that of his son Robert III. harassing and unfortunate for the people. Robert II. died in 1390, and Robert III. in 1406. The succeeding monarchs of the line (all of whom are treated in separate articles) were James I., assassinated in 1437; James II., who was accidentally killed in 1460; James III., murdered in 1488; James IV., slain in the battle of Flodden in 1513; James V., son of the preceding and of Margaret Tudor, sister of Henry VIII. of England, who died in 1542; Mary, executed in England in 1587; her son James VI., who succeeded Queen Elizabeth as James I. of England, and died in 1625; Charles I., executed in 1649; Charles II., who died in 1685; James II., who died in 1701, and was the last reigning male member of the family, though his daughter Mary, wife of William of Orange, came to the throne after his expulsion in 1688 as queen regnant with her husband, and his second daughter Anne succeeded her in 1702, reigning till her death in 1714. The only son of James II., James Francis Edward Stuart, was a pretender to the throne of England, and died in Rome in 1766. His son Charles Edward Stuart (born in 1720, died in 1788) was a second pretender. Henry Stuart, Cardinal York, brother of Charles Edward, was the last of the male line of the family, and with his death in 1807 it became extinct. Its chief branches in the female line are the houses of Savoy and Orleans, both descended from Henrietta Anna, daughter of Charles I. The late duke of Modena, who was that king's lineal representative, and thus, but for the act of settlement, heir to the crown of England, died childless in November, 1875. (See Charles Edward, James Francis Edward, and Stuart, Henry Benedict Maria Clement.)

**STUART, Arabella** or **Arbella,** often called the lady Arabella, the only child of Charles Stuart, earl of Lennox, brother of Darnley and uncle of James I., born about 1575, died in the tower of London, Sept. 27, 1615. She was related to Queen Elizabeth in the same degree as her cousin James, the successor to the throne; and this relationship made her the subject of constant intrigues. An early plan to marry her to her relative Lord Esme Stuart was defeated by Elizabeth's opposition; several similar schemes failed from various causes; and she was still unmarried when in 1603 Sir Walter Raleigh was accused of a plot to raise her to the throne. This design probably never existed, but the accusation brought her into public notice, and made her situation still more dangerous; and further hostility was aroused against her by the discovery in 1610 that she had been secretly married to William Seymour, grandson of the earl of Hertford. Seymour was at once committed to the tower, and the lady Arabella placed in the custody first of Sir Thomas Parry at Lambeth and afterward of the bishop of Durham. While on the journey to Durham she escaped by feigning illness (June, 1611), and made her way to a French vessel waiting for her and her husband, the latter having also escaped from the tower. He did not get to the ship, which sailed without him; but it was captured before reaching the French coast, while the small vessel in which

he took passage later made the passage safely. Lady Arabella was thrown into the tower, where she became ill from neglect and ill treatment, and finally insane a short time before her death.

**STUART, Gilbert,** a Scottish author, born in Edinburgh in 1742 or 1746, died in Musselburgh, Aug. 13, 1786. He was educated at the university of Edinburgh, and in 1767 published a "Historical Disquisition concerning the Antiquity of the British Constitution," which procured him the degree of LL. D., and in 1768 "View of Society in Europe in its Progress from Rudeness to Refinement." He failed to procure a professorship in Edinburgh on account of his dissipation, spent several years in London, and in 1773 started the "Edinburgh Magazine and Review," in which for four years he published savage attacks upon prominent Scottish authors. He afterward again lived for some time in London. His remaining works are: "Observations concerning the Public Law and Constitutional History of Scotland" (8vo, Edinburgh, 1779), an attack on Dr. Robertson, whom he especially hated; "History of the Establishment of the Reformation of Religion in Scotland" (4to, London, 1780); and "History of Scotland from the Reformation to the Death of Queen Mary" (2 vols. 8vo, London, 1782).

**STUART, Gilbert Charles,** an American painter, born in Narragansett, R. I., in 1756, died in Boston in July, 1828. He received his first instructions from a Scottish painter named Alexander, by whom, when about 18 years of age, he was taken to Edinburgh. His master died soon after their arrival in that city, and Stuart worked his passage home before the mast, and began practice as a portrait painter at Newport, R. I. He removed successively to Boston and New York, and set sail in 1778 for London, where for two years he made little progress, and suffered greatly from poverty; but becoming acquainted with Benjamin West, he received valuable assistance from him, and for several years resided in his family. About 1781 he began practice in London on his own account, and soon rose to great eminence as a portrait painter, rivalling Reynolds and the best English artists of the day. Subsequently he resided successively in Dublin and Paris, and in 1793 returned to America. He went to Philadelphia to paint a portrait of Washington, and destroyed his first picture; but at the second sitting he produced the well known head from which he painted all his other portraits of Washington, and which has long been regarded as the standard likeness. The original study, together with a head of Mrs. Washington, is now in the possession of the Boston Athenæum. After residing several years in Washington, he settled in 1806 in Boston. As a painter of heads he holds the first place among American painters, if we except Copley, and his flesh coloring rivals the finest modern efforts. Upon accessories he bestowed little labor, and they are sometimes finished in the most slovenly manner.

**STUART, Henry Benedict Maria Clement,** Cardinal York, the last of the Stuart family in the male line, born in Rome in 1725, died at Frascati in 1807. He was the son of the pretender James Francis Edward, who created him duke of York, and the younger brother of the "young pretender" Charles Edward, whom he was preparing to aid with a body of French troops assembled at Dunkirk when the overthrow of the Jacobites at Culloden ruined the Stuart cause in Britain. He subsequently took orders in the Roman Catholic church, and in 1747 was appointed by Benedict XIV. a cardinal, the ducal title given him by his father, though valueless in England, being recognized by the pope in the style of his nomination as Cardinal York. On the death of his brother in 1788 he assumed the title of king of England as Henry IX., *gratia Dei, non voluntate hominum*, as the medal struck on the occasion declared. On the occupation of the Papal States by the French he retired to Venice, and in his last years was dependent upon the British court for the means of subsistence.

**STUART, James,** sometimes called Athenian Stuart, an English antiquary, born in London in 1713, died Feb. 2, 1788. In early life, till about 1742, he painted fans. He then went to Rome, where he studied art, the ancient languages, and archæology. In 1750 he accompanied Nicholas Revett on an antiquarian tour to Greece, remaining in Athens from March, 1751, to the close of 1753. Returning to London in 1755, he engaged in the practice of architecture, and began, at first in conjunction with Revett, a work on the "Antiquities of Athens." The work was completed in 4 vols. imp. fol., with 384 plates; the first volume appeared in 1762, and the other three were edited respectively by Newton (1787), W. Reveley (1794), and Joseph Woods (1816). A second edition of the first three volumes with smaller plates, and a supplementary volume with 50 plates, were published by Kinnard (1825–'30). Among other editions is one in French (4 vols. fol. and a supplementary volume, Paris, 1808–'32).

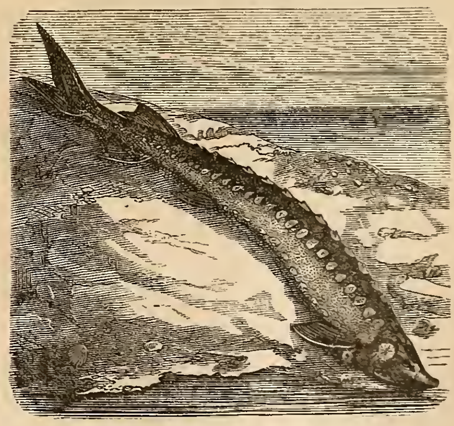
**STUART, John,** earl of Bute. See Bute.

**STUART, Moses,** an American author, born at Wilton, Conn., March 26, 1780, died in Andover, Mass., Jan. 4, 1852. He graduated at Yale college in 1799, was admitted to the bar in 1802, and for the two succeeding years was a tutor in Yale college. He afterward studied theology, and was ordained pastor of the first Congregational church of New Haven, March 5, 1806. From 1809 to 1848 he was professor of sacred literature in the theological seminary at Andover. He published a "Grammar of the Hebrew Language without Points" (Andover, 1813); "Letters to the Rev. William E. Channing, containing Remarks on his Sermon recently preached and published in Baltimore" (1819); a "Grammar of the Hebrew Language

with Points" (1821); "Letters to Dr. Miller on the Eternal Generation of the Son of God" (1822); "Commentary on the Epistle to the Hebrews" (2 vols. 8vo, 1827–'8); "Hebrew Chrestomathy" (2 vols., 1829–'30); "Exegetical Essays upon Several Words relating to Future Punishment" (1830); "Commentary on the Epistle to the Romans" (1832); "Is the Mode of Christian Baptism prescribed in the New Testament?" (1833); "A Grammar of the New Testament Dialect" (1834); "Philological View of Modern Doctrines of Geology" (1836); "Hints on the Prophecies" (2d ed., 1842); "Commentary on the Apocalypse" (2 vols., 1845); "Critical History and Defence of the Old Testament Canon" (1845); "Commentary on Daniel" (1850); "Conscience and the Constitution" (1851); "Commentary on Ecclesiastes" (New York, 1851); and "Commentary on Proverbs" (1852). He also published several translations, including "Elements of Interpretation," from the Latin of Ernesti (Andover, 1822); "Hebrew Grammar," from the German of Gesenius (1825); with Edward Robinson, "Greek Grammar of the New Testament," from the German of Winer (1825); and "Discrepancies between the Sabellian and Athanasian Methods of Representing the Doctrine of the Trinity," from the German of Schleiermacher (1835).

**STUHL-WEISSENBURG. I.** Properly Weissenburg (Hung. *Fejér*), a county of S. W. Hungary, bounded E. by the Danube; area, 1,605 sq. m.; pop. in 1870, 196,234, chiefly Magyars. The N. part of the county is mountainous, while the S. is level. Among the products are tobacco, wine, and marble, and there are several mineral springs. **II.** A city, capital of the county (Hung. *Székes-Fejérvár;* Lat. *Alba Regia*), on the left bank of the Csorgó, near the border of an extensive morass, 38 m. S. W. of Buda; pop. in 1870, 22,683. The principal buildings are the cathedral and the episcopal palace. There are manufactures of woollen and linen goods, hardware, and several other articles. The kings of Hungary were crowned here down to Ferdinand I., and the cathedral contains many of their tombs. Four tombs dating from the 13th century, and other relics, were excavated in 1874, including those of a remarkable chapel.

**STURGEON,** the name of cartilaginous fishes of the class of ganoids and family *sturionidæ.* The body is elongated and fusiform, covered with a rough skin protected by five longitudinal rows of tubercular plates; the largest of these rows is along the back, and there is also one on each side, and one from each pectoral to the ventral fins; the plates are flattened, and marked with radiating striæ. The head is depressed, and ends in a long triangular snout covered with bony plates; mouth funnel-shaped and protrusible, on the under surface, without teeth, having in front a few depending barbels, evidently organs of touch; gill covers very large and gills free; pseudo-branchiæ and spiracles are present, but no branchiostegal rays; fins well developed, the dorsal and anal opposite and behind the ventrals; tail heterocercal or unsymmetrical, the vertebral cord being prolonged into the upper lobe as in the sharks, and strengthened by fulcra along its upper margin; a soft caudal on the under surface of the tail. The vertebral column consists of an undivided soft *chorda dorsalis;* the air bladder is very large, communicating freely with the œsophagus; there is a spiral valve in the intestine, and a conglomerate pancreas. They are generally large, and inhabit the northern temperate seas of both coasts of America, eastern Europe, and western Asia, from which they ascend the rivers in spring to spawn, returning to the salt water in autumn; species are also found in the great American fresh-water lakes, which never descend to the sea. They are oviparous; the food consists of any soft substances which they stir up from the bottom with their snouts, and of small fish; they frequently jump out of water.—The genus *acipenser* (Linn.) has the characters of the family. The common sturgeon of Europe (*A. sturio*, Linn.) attains a length of 6 to 10 ft., and sometimes more; it is found in the Caspian and Black seas and the rivers opening into them, and sometimes on the coasts of Great Britain and the Baltic; the flesh is delicate, and is largely consumed in



Common European Sturgeon (Acipenser sturio).

Russia, fresh, salted, and pickled. A larger species, also found in the seas and rivers of S. E. Europe, is the beluga (*A. huso*, Linn.), attaining a length of 12 to 15 ft. and a weight of 1,200 lbs., and occasionally much larger; it ascends the rivers opening into the Caspian and Black seas, with other and smaller species. The flesh is tough; the sound or air bladder furnishes an abundant supply of isinglass, for which great numbers are caught in Russia. Caviare is also made from the roe of the female, which sometimes constitutes one third of the weight of the fish; the skin is used for

harness leather, and the dorsal cord, cut in pieces and dried, is used as food. The sterlet (*A. Ruthenus*, Linn.), found in the Caspian, and growing to a length of 2 or 3 ft., furnishes a most delicate food and the best caviare. In the Volga it spawns early in May, on rocky bottoms, in water of 54° F.; the eggs, which are easily fecundated artificially, soon adhere to any object; they are hatched in about seven days, the embryos being then about a quarter of an inch long; in ten weeks these attain a length of two inches, feeding on larvæ of insects on the bottom. Both eggs and young will safely bear a journey of five days, and have been carried to W. Russia, and even to stock British rivers; the young live only in fresh water. The color in these species is brown of various shades, the plates whitish, and the abdomen silvery. The several species in the Baltic hybridize freely, and are probaby only varieties of one.—In North America sturgeons are not found north of the watersheds between lat. 53° and 54° N., where the mean annual temperature is about 33° F.; they seldom enter clear cold streams, but ascend muddy rivers in such numbers that many large Indian tribes subsist entirely on their flesh in summer; each watershed has its own species, varying in some minor characteristics. The sharp-nosed sturgeon (*A. oxyrhynchus*, Mitch.) attains a

Sharp-nosed Sturgeon (Acipenser oxyrhynchus).

length of from 3 to 7 ft.; it is found on the coasts of New England, New Brunswick, and Nova Scotia; it is common in Long Island sound from the middle of June to October, and is taken by harpoon and in nets; the smaller specimens are esteemed for the table; it is grayish brown above, silvery on the sides, and white below. The short-nosed sturgeon (*A. brevirostris*, Mitch.) is dusky above and white below; the snout is short and blunt; it attains a length of 2 to 5 ft., and is so common in the Hudson that its flesh in the market has been known as Albany beef; it much resembles the *A. sturio* of Europe. Other species are described from the northern waters, the rivers of the N. W. coast, and from Lake Superior, by Richardson and Agassiz.—The genus *polyodon* (Lacép.) or *spatularia* (Shaw) has the general form of *acipenser*, but is without the bony plates on the body and head; the snout is very much elongated, and compressed into a thin leaf-like organ, partly bony and partly cutaneous, sometimes nearly as long as the body; gill covers very large, extending far back in a membranous point; the mouth is wide, with numerous minute teeth in the young animal, which are lost with age. The spoon-bill sturgeon (*P. folium*, Lacép.) is steel-blue above and white below; it attains a length of 5 ft., and is found in the Mississippi, Ohio, and their tributaries; it is also called shovel fish and paddle fish; the flesh is tough; the singularly shaped snout is used to shovel up the mud in search of food. The genus *platirostra* (Les.) is probably only the adult of *polyodon*, the principal difference being the absence of teeth.

**STURLESON.** See SNORRI STURLASON.

**STURT,** Sir **Charles,** an English explorer, died in Cheltenham, June 16, 1869. He entered the army at an early age, and in 1825 (being then a captain) was stationed at Sydney, New South Wales. At this time the interior of Australia was almost entirely unknown; and in 1828 Gen. Darling organized an exploring expedition. Oxley ten years before had been stopped by the great swamps W. of the Blue mountains, and this expedition was to penetrate beyond them as far inland as possible. Sturt was attached to the party, and soon took the virtual lead of it. He discovered the Macquarie, Castlereagh, and Darling rivers, and explored a great portion of their valleys. Later he led another expedition, explored the course of the Murrumbidgee, discovered (June 14, 1830) the great Murray river, followed it to Lake Alexandrina, and returned at the beginning of 1831. The account of these journeys was published in London in 1833, under the title of "Two Expeditions into the Interior of South Australia during the years 1828–'31." His health, and especially his eyesight, had suffered greatly; and he was compelled to rest for several years before undertaking his next expedition, which was overland from Sydney to Adelaide. At Adelaide he was made surveyor general of South Australia. In 1844 he undertook a fourth journey, and, after the greatest hardships in the Stony Desert, reached a point near the centre of the continent. This expedition he described in a report published in London in 1849. After his return he became registrar general and later colonial secretary of South Australia; but the injury to his eyes resulted in total blindness, and he returned to England. He was knighted a few days before his death.

**STUTSMAN,** an E. central county of Dakota, recently formed and not included in the census of 1870; area, about 2,100 sq. m. It is drained by the head waters of the Dakota or James river. The W. part is occupied by the Plateau du Coteau du Missouri. The Northern Pacific railroad traverses it from E. to W. The surface is rolling.

**STUTTERING.** See STAMMERING.

**STUTTGART,** a city of Germany, capital of the kingdom of Würtemberg, 2 m. S. W. of Canstatt on the Neckar, and 97 m. S. E. of Frankfort; pop. in 1876, over 107,000, including 9,000 in several villages. It stands in a very beautiful valley surrounded by vine-clad hills, with wooded mountains in the distance. The town is generally well built, and is divided by the long Königsstrasse, the principal street, extending nearly N. and S. throughout its en-

tire length, and bordered by the chief business buildings. In the principal square is a fine old Gothic church, with a high tower and many ancient sculptures and monuments of the princes of Würtemberg. The royal (formerly ducal) palace, begun in 1746 and finished

The Old Palace.

in 1806, is a large building of freestone finely decorated and furnished in the interior; the old palace, completed in 1570, resembles a mediæval castle, and is now occupied by officials connected with the government. In the same square is a monument to Schiller by Thorwaldsen. The hospital church is a Gothic building, finely decorated in the interior, and contains the original model of Dannecker's "Christ." The town hall was built in the 15th century. There is a museum of natural history; a royal library of 450,000 volumes and 3,500 manuscripts; a cabinet of medals containing more than 17,000 specimens; a museum of the fine arts, with many valuable statues and pictures; a bazaar, and a theatre. Stuttgart has also a gymnasium, military academy, polytechnic school, a royal school of art, attended in 1874–'5 by about 100 students, and a conservatory of music, attended in January, 1875, by 576 male and female pupils, including 79 from the United States and 53 from England. The manufactures include woollen, silk, linen, and cotton goods, jewelry, musical and philosophical instruments, leather, and tin ware. The book trade is extensive, and connected with it are numerous paper mills, type founderies, and lithographic establishments. The town is the central point of the Würtemberg railways, seven lines extending from it; and the railway station is perhaps the finest in Germany. There is a horse railway between Stuttgart and Canstatt, a pleasant suburb and favorite summer resort. Besides the public garden, which is one of the finest in Germany, there are in the vicinity numerous parks and gardens, where the public are admitted; that of Rosenstein, the king's summer palace, and the gardens of the Wilhelma palace at Canstatt, are the most beautiful.—The date of the foundation of Stuttgart is not accurately known. It is mentioned as early as 1229, and was selected as a residence by Count Eberhard in 1320. In 1482 Count Ulric made it the capital of Würtemberg. The city had little of its present beauty until the middle of the 18th century; after that time it was greatly improved during several successive reigns, owing its chief embellishments to Kings Frederick and William. The population and prosperity of Stuttgart have of late much increased.—See Wochner's *Stuttgart seit 25 Jahren* (Stuttgart, 1871).

**STUYVESANT, Petrus,** the last Dutch director general of New Netherland (New York), born in Holland in 1602, died in New York city in August, 1682. He served in the war in the West Indies, was director of the colony of Curaçoa, lost a leg in battle, and returned to Holland in 1644. In 1645 the Dutch West India company appointed him director general of New Netherland. He arrived in May, 1647, conciliated the savages, who had been provoked to hostilities by his predecessor William Kieft, and restored order in every department. In 1650 he arranged at Hartford with the New England commissioners a line of partition, before undefined and disputed, between the Dutch and English territories. In 1651 the Dutch built Fort Casimir on the Delaware, which was captured by Rising, the governor of New Sweden, in 1654. Next year Stuyvesant sailed into the Delaware with seven vessels and 600 or 700 men, and took the whole settlement. For the next ten years there was nearly unbroken peace. In 1653 a convention of two deputies from each village in New Netherland demanded that "no new laws shall be enacted but with the consent of the people; that none shall be appointed to office but with the approbation of the people; that obscure and obsolete laws shall never be revived." Stuyvesant commanded the separation of this assembly on pain of punishment, telling them: "We derive our authority from God and the company, not from a few ignorant subjects." The spirit of resistance nevertheless increased. The encroachments of the New England colonies induced Stuyvesant to remonstrate before a convention of the united colonies at Boston, but he met with little favor; and a second embassy to Hartford had no better success. In 1664 Charles II. granted to his brother, the duke of York, the territory from the Connecticut river to the shores of the Delaware, and an English fleet under Richard Nicolls appeared in the bay of New York in August and demanded the surrender of the city. Stuyvesant was unwilling to capitulate, but the municipality, seeing the futility of resistance, insisted on yielding; and at last he consented, and the city was given up on Sept. 3, 1664. Stuyvesant went in 1665 to report to his superiors in Holland, but returning, spent the remainder of his life on his farm or *bouwerij* (whence the name of the street called the Bowery), then outside the limits of the city. He lies buried in the vaults of St. Mark's church in 10th street.

**STY** (Lat. *hordeolum*, from *hordeum*, barley), a small inflammatory tumor on the edge of the

eyelid, about the size of a grain of barley. Sty has its seat in the cellular tissue at the margin of the lid, involving generally the roots of one or more of the eyelashes. The tumor is furuncular, and almost invariably goes on to suppuration; its progress is sometimes tedious and the suppuration imperfect. Sty is most common in persons of a strumous habit, and often has for an exciting cause derangement of the digestive organs. When the little tumor has made its appearance, it is best to promote its maturation by warm and emollient fomentations. It is commonly advisable to leave it to burst of itself; but when maturation has occurred, if it occasion much uneasiness, it may be punctured.

**STYLE, Old and New.** See Calendar.

**STYRAX.** See Balsams.

**STYLITES** (Gr. στυλίτης, belonging to a pillar), a class of anchorites who spent their lives on pillars. The originator of this mode of Christian penance was Simeon (known as St. Simeon Stylites), a Syrian, who was born in Sisan or Sesan about 390, and died near Antioch in 459. He spent several years in convents, but not being satisfied with the severity of their discipline, he built for himself on Mt. Telanissa a small hut, in which he inflicted upon himself all manner of bodily pains, in the hope of thereby attaining to spiritual perfection. His fame drew around him large numbers of admirers, and in order to escape their constant intrusions and persistent efforts to approach him and touch his garments, he decided to live on top of a pillar. At first he maintained himself standing upon it by means of a beam, but he soon learned to do without this support, and to obtain rest by leaning against the low parapet. His pillar was at first only about 10 ft. high, but he had it repeatedly increased in height, until it was about 60 ft. high. On this pillar, the top of which is said to have measured only a few feet in circumference, he lived upward of 30 years; and when he died the people of Antioch received his body into their city and revered him as their patron saint. His example found numerous imitators in the East, but his peculiar kind of asceticism met with little favor in the West. He and his followers received the designation of stylites, but are known also as air martyrs, pillarists, and pillar saints. There were several other stylites called Simeon. One died in 595, and another, one of the last recorded in history, lived in the 12th century. It is related of one Alypius that he maintained himself 70 years on a pillar near Adrianople.

**STYRIA** (Ger. *Steiermark*), a duchy of Austria, bordering on Upper and Lower Austria, Hungary, Croatia, Carniola, Carinthia, and Salzburg; area, 8,671 sq. m.; pop. in 1870, 1,137,990. It is divided into the circles of Gratz, which contains the capital of the same name, Marburg, and Bruck. It is traversed by three chains belonging to the Noric branch of the Alpine system, the highest summits of which are on the N. W. and S. W. frontiers, rising to an elevation of 8,000 ft. and upward. The N. W. part is known as Upper Styria, and the country in the opposite direction as Lower Styria. The surface belongs to the basin of the Danube. The most important streams are the Mur, Enns, Raab, Save, and Drave, all of which except the Raab are navigable for boats. There are numerous small lakes, and hot and mineral springs. Limestone, sulphur, alum, rock salt, gold, silver, lead, copper, cobalt, zinc, and iron ore of superior quality are found. The soil in the valleys is generally fertile, but no surplus of grain is produced. The vine thrives well. The forests cover about half the surface. The inhabitants are mostly German, but the Winds or Slovens are numerous, constituting about 36 per cent. of the population; nearly all are Roman Catholics. Iron is extensively manufactured, and linen, cotton, woollen, and silk to some extent; but the most important branch of industry is timber. Millions of jewsharps are annually exported.—Under the Romans the eastern part of Styria belonged to the province of Pannonia, and the western to Noricum. Christianity was introduced in the 4th century, but the northern barbarians afterward overran the province. Styria was annexed to Austria in 1192, was subsequently attached to Bohemia, and in 1276 together with other territories surrendered by King Ottocar II. to Rudolph I. of Hapsburg. It subsequently belonged to various branches of that house, until the Styrian line became the ruling one with the succession of Ferdinand II. to the emperor Matthias in 1619. Ferdinand exterminated Protestantism in the duchy. Under the constitution of Cisleithan Austria the Styrian diet elects 13 members to the Austrian Reichsrath.—See *Das Volksleben in Steiermark in Charakter- und Sittenbildern dargestellt*, by P. K. Rosegger (2 vols., Gratz, 1875).

**STYX** (connected with Gr. στυγεῖν, to abhor), in Greek mythology, the chief river of the lower world, around which it flows seven times. The name was said to be derived from the nymph Styx, the daughter of Oceanus, who, when Jupiter prepared to wrest the power from the hands of Saturn and the Titans, was the first of the immortals to answer to his call, coming with her children to his assistance. He made her children his constant attendants, and herself the oath-sanctioner of the gods. In the Hesiodic theogony Styx is called the daughter of Oceanus and Tethys. She was the mother of Zelos (zeal), Nike (victory), Bia (strength), and Cratos (power).

**SUABIA.** See Swabia.

**SUAKIN**, or **Suakim**, a seaport town of Nubia, on the coast of the Red sea, 285 m. N. N. W. of Massowah; lat. 19° 17′ N., lon. 37° 20′ E.; pop. about 6,000. The town proper is on an island 1½ m. in circumference, which is connected by a bridge with a suburb on the mainland. It is defended by a small fort,

and contains several mosques and public buildings, the principal of which are the governor's house, custom house, and bazaar. The harbor is sheltered from all winds, but is too shallow to admit large vessels. The adjacent country is a level plain. The climate is very hot. Suakin is fast increasing in commercial importance, and has a considerable trade in cattle, hides, butter, ivory, ostrich feathers, gum arabic, cotton, and coffee, the last from Abyssinia. More than 150 vessels enter its port yearly. It was formerly subject directly to the Turkish power, but in 1865 was surrendered to the viceroy of Egypt. In 1870 telegraphic communication was established with the Soodan, an attempt to effect which in 1865 had resulted in the loss of the engineers and 8,000 camels. There is a direct caravan route from Suakin to Berber, on the Nile, and to Khartoom, and great numbers of pilgrims pass over it yearly on their way to Mecca.

**SUAREZ, Francisco,** a Spanish theologian, born in Granada, Jan. 5, 1548, died in Lisbon, Sept. 25, 1617. He early entered the order of Jesuits, and was successively professor at the universities of Alcalá, Salamanca, Rome, and Coimbra. His *Defensio Fidei*, &c. (Coimbra, 1613), was in 1614 ordered by the parliament of Paris to be burned, because it claimed for the pope a coercive power over kings. In the same year and subsequently it was reprinted at Cologne. His complete works appeared at Lyons and Mentz (23 vols. fol., 1630 *et seq.;* new eds., Venice, 1740, and Besançon, 1856–'62). Francisco Noël prepared an abridged edition (2 vols. fol., Geneva, 1732; republished by J. P. Migne, Paris, 1858). The life of Suarez has been written in Latin by Deschamps (Perpignan, 1671), and in German by Werner (Ratisbon, 1861 *et seq.*).

**SUBLIMATION,** a process of distillation in which the vapors condense in a solid form. It takes place naturally in volcanic fissures and craters. Deposits thus formed are termed sublimates. A great variety of mineral substances are subject to vaporize by heat and become solid again on cooling; and the number of such increases with the increased degree of heat which we can apply. Some vegetable substances also possess the same property, as camphor and benzoin. Sublimation is much employed as a means of separating volatile from fixed bodies, usually for obtaining the former in a purer state. The vapor is sometimes chemically changed by contact with the oxygen of the air, and the sublimate is then of a different composition from the original body, as when oxide of zinc is produced by subjecting the metal or its ores to heat exposed to the air.

**SUBLIME PORTE** (Fr., lofty or magnificent gate; Turk. *babi humayun;* Ar. *ed-davlet el-aliye*), the title officially given to the Ottoman government. Orkhan (1326–'60) erected in his capital Brusa a palace with an imposing entrance, on which he bestowed the name of "Sublime Porte," which from that time to the present has been applied to the monarch and government of the Ottomans. This use of the term is partly owing to the oriental custom of transacting public business at the gate or in the antechamber of the palace.

**SUBPŒNA,** a judicial process directed to a witness commanding him to appear at the court, to testify what he knows in the case therein described, under a certain penalty (*sub pœna*) mentioned in the process. If the court wishes to examine any books or papers which are in possession of the witness, a clause is inserted bidding him to bring them with him; and the subpœna is thence called a *subpœna duces tecum.* The subpœna ought to be served upon the witness personally, for otherwise he cannot be proceeded against as for a contempt if he neglects to appear. Service may be made by any person, and is proved generally by affidavit, or, if it be made by a sheriff or his officer, by a simple return or certificate of service. When a witness has been duly summoned, and his fees have been paid or tendered, or payment or tender has been waived, he is guilty of a contempt of court if he fails to appear at the appointed time, and may be proceeded against by attachment, for the double purpose of compelling him to appear and testify, and of vindicating the dignity of the court by the infliction of suitable punishment. The party actually injured by the non-appearance may also have an action for all damages caused by his default.—The office of the subpœna at common law is simply to bring into court a witness whose evidence is sought. Chancery, borrowing the name of the writ, but giving it a far larger scope, issued it in order to compel a defendant in a cause to appear and answer upon oath the plaintiff's allegations. This process in chancery answers to a summons in the courts at law, and is the process by means of which the defendant is constructively brought before the court.

**SUBROGATION.** Where one person becomes entitled in law to the position of another as creditor or as the holder of securities, he is said to be subrogated to the rights of the other, and in contemplation of law there is a substitution or subrogation. When a surety pays the debt of his principal, he becomes subrogated to the rights of the creditor in any securities he may have held, with the right to enforce them for his own indemnity. So if one having a lien on property pays off a prior lien for the protection of his own, he becomes entitled to hold it against the interest of those who should have paid; and so would one tenant in common who should discharge a mortgage upon the whole title. The doctrine rests on principles of equity, and is one of very general application.

**SUBSCRIPTION,** in law, a contract by which one agrees to contribute with others for a common purpose. The word is sometimes applied to the sum of money subscribed. The contract

of subscription depends for its validity upon the same principles and facts as other contracts. The subscribers may be sued for their subscriptions whenever the conditions upon which they have promised to pay are fulfilled, if the purpose of the contract is legal and founded upon a good consideration, and if there is a party capable of maintaining the action. Subscription papers are often hastily drawn up and carelessly expressed, and the difficulty in the way of enforcing contracts of subscription has arisen chiefly from the want of proper parties and of a valid consideration for the promise. In their disposition to uphold this class of contracts, if they can be upheld consistently with the rules of law, the courts have gone in some cases so far as to say that the subscribers to a common object may be treated as contracting with each other, the consideration of each subscription being the promises of the other contributors, each subscriber being thus liable to a suit by all the others. There seems to be some difficulty in sustaining this view, and to avoid it subscriptions are usually made payable to some corporation or person who is to act as treasurer for the purpose of collection, and perhaps also in expending the moneys. Such undertakings, made on behalf of educational and charitable institutions or other public objects, or even for public celebrations, have frequently been sustained and enforced, and there seems to be no sufficient reason against such action. If by the subscription paper the promisee expressly undertakes to apply the moneys to the object in view, the case is clear; and certainly, if in any other case the subscription be accepted and acted upon by the expenditure of moneys or otherwise before notice that subscriptions are withdrawn, it should be held that this constitutes a consideration sufficient to support the promises, and that they cannot be withdrawn subsequently, but may be enforced. And such seems to be the tendency of decisions.

**SUCCINIC ACID,** an acid found ready formed in amber and in certain lignites, and occasionally in the animal organism. It may be obtained in colored crystals by heating amber in retorts. It is formed artificially in several ways, as by the action of hydriodic acid on malic acid or tartaric acid, or by the oxidation of certain fatty acids. It is most conveniently prepared by the fermentation of malic acid, the crude malate of calcium obtained by adding chalk or slaked lime to the juice of mountain ash berries being used for the purpose. The malate is mingled with water and yeast or decaying cheese, and kept for a few days at 86° or 100° F., when succinate of calcium forms. This salt is then decomposed by sulphuric acid, insoluble sulphate of lime being thrown down, while succinic acid is left in solution, and may be obtained by evaporation and cooling in colorless oblique rhombic prisms, soluble in five parts of cold and three parts of boiling water. The combinations of succinic acid with bases are called succinates, of which the most important are the calcium succinate above mentioned and succinate of ammonia. Succinic acid, though formerly officinal, is now seldom used in medicine. Succinate of ammonia is said to have been used with success in delirium tremens.

**SUCCORY.** See CHICCORY.

**SUCHET, Louis Gabriel,** duke of Albufera, a French soldier, born in Lyons, March 2, 1770, died in Marseilles, Jan. 3, 1826. He entered the army in 1792, was at the siege of Toulon in 1793 as chief of battalion, and was then transferred to the army of Italy. He was selected as one of the commanders in the army of Egypt, but was detained by Brune as major general in the army of Italy, in which he reëstablished order and discipline; afterward served as chief of staff under Masséna on the Danube, and again in Italy as general of division; and in 1800 distinguished himself in the defence of Genoa. In 1805 he commanded the left wing under Lannes at Austerlitz, and in 1806 took an important part in the battle of Jena. In 1808 he was made commander of a division in the army of Spain, and after successive victories he became marshal in 1811. He afterward took Oropesa and Murviedro, and defeated Blake near the lagoon of Albufera, under the walls of Valencia, and forced him to surrender that city, Jan. 9, 1812, with 18,000 Spanish troops and immense stores. For this victory he was rewarded with the title of duke of Albufera and a large revenue. He gained the esteem of the Spaniards by his justice and moderation. Louis XVIII. made him a peer in 1814. He wrote *Mémoires sur la guerre d'Espagne*, 1808-1814 (2 vols. 8vo, Paris, 1829).

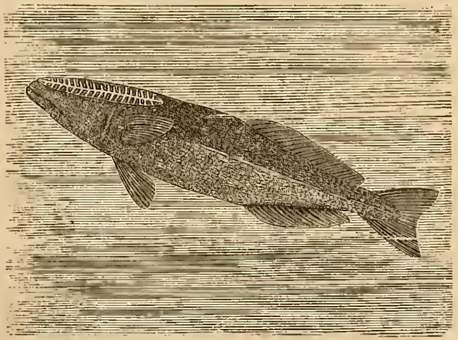
**SUCKER,** the popular name of the soft-rayed fishes of the carp family (*cyprinidæ*) included in the genus *catostomus* (Lesueur). They are characterized by a single dorsal, three rays in the gill membrane, smooth head and gill covers, jaws without teeth and retractile, mouth beneath the snout, and lips plaited or lobed suitable for sucking; there are comb-like teeth in the throat; the intestine is very long, and the air bladder divided into two or more parts. There are about 30 species in the fresh-water rivers and lakes of North America; they rarely take bait, and are very tenacious of life. The common sucker (*C. Bostoniensis*, Les.) is 8 to

Common Sucker (Catostomus Bostoniensis).

15 in. long, of a brownish color, olive on the head, reddish with metallic lustre on the sides, and white below; it is common in New England and the middle states. The chub sucker

(*C. gibbosus*, Les.) is 7 to 12 in. long, dark brown above, golden greenish yellow on the sides, anterior part of abdomen whitish, and fins dark; body convex in front of dorsal, and sides of head sometimes spiny or tuberculated; it is common in the ponds of the New England and middle states. Large species from the northern regions have been described by Richardson and Agassiz. Among the larger species of the western rivers are the Missouri sucker (*C. elongatus*, Les.), 2 to 3 ft. long, in the Ohio river, black on the back, and hence called black horse and black buffalo; and the buffalo sucker (*C. bubalus*, Raf.), of about the same size, in the Ohio, Mississippi, Missouri, and their tributaries, brownish above, bronzy on the sides, and whitish on abdomen.

**SUCKING FISH,** the popular name of the remora, a spiny-rayed fish of the genus *echeneis* (Linn.), so named from the Greek *ἔχειν*, to hold, and *ναῦς*, a ship. The body is elongated, tapering behind, covered with very small scales;



Mediterranean Sucking Fish (Echeneis remora).

there are four perfect branchiæ; very small teeth on jaws, vomer, and palate, crowded and hardly distinguishable posteriorly; mouth small and horizontal, the lower jaw the longer; eyes above the angles of the mouth; ventrals thoracic, narrow, united only at the base; head flattened. Above the head and anterior dorsal vertebræ is an oval disk, presenting from the middle to both sides oblique transverse cartilaginous plates, arranged like the slats of a Venetian blind; on the middle of the under surface are spine-like projections connected by short bands with the skull and vertebræ, and their upper margin is beset with fine teeth. According to De Blainville, this organ is an anterior dorsal fin, whose rays are split and expanded horizontally on each side instead of standing erect in the usual way. By means of this apparatus, partly suctorial and partly prehensile by the hooks, these fishes attach themselves to rocks, ships, and the bodies of other fishes, especially to sharks. The dorsal is opposite the anal, but the fins are weak, and these fishes accordingly adhere to sharks and other moving bodies, which transport them to places where food is abundant, and often from the tropics to temperate regions. There are six or eight pyloric appendages, but no air bladder. The common sucking fish of the Mediterranean, so well known to the ancients (*E. remora*, Linn.), is from 12 to 18 in. long, shaped somewhat like a herring, dusky brown above and lighter below; it has 17 or 18 plates on the head; it occurs in the Atlantic ocean, on the British coasts, and has even wandered to the American shores. The Indian remora (*E. naucrates*, Linn.) attains a length of 2½ ft.; it is olive-brown above and whitish on the sides, and has 22 to 24 plates in the sucking disk; it is found in the Atlantic, on the American and African coasts, in the Red sea, Indian ocean, and even around Japan. Peculiar to the American coast is the white-tailed remora (*E. albicauda*, Mitch.); it is from 1 to 2 ft. long, grayish slate above, with dark band on sides; the disk has 21 plates; it is not uncommon on the southern shore of Massachusetts and in Long Island sound, where it is generally called shark sucker. None of the species feed upon the fish to which they are attached, their food being small fishes and floating animals. (See LUMP FISH.)

**SUCKLING, Sir John,** an English poet, born at Whitton, Middlesex, in 1609, died in Paris probably in 1642. He was educated at Cambridge, inherited an immense fortune from his father, comptroller of the royal household, and in 1631–'2 served as a volunteer under Gustavus Adolphus. He was afterward a member of the court of Charles I., and in 1639 he equipped a body of 100 horse for the royal service, but was disgraced by pusillanimous conduct in an encounter with the Scots near Dunse. In 1640 he was elected to the long parliament; but having joined in a plot to rescue Strafford from the tower, he was compelled to take refuge in France. His literary remains include four plays, a number of short poems, chiefly amatory, and a treatise on "Religion by Reason." His works were published by Tonson in 1709, and in 1836 appeared "Selections from his Works," with a memoir by the Rev. Alfred Suckling. A new edition of his "Poems, Plays, and Remains" was published in London in 1874.

**SUCRE, or Chuquisaca,** the capital of Bolivia and of the department of Chuquisaca, on a plateau above the Rio de la Plata, about 10,000 ft. above the sea; lat. 19° 20′ S., lon. 65° 17′ W.; pop. in 1865, 26,664, the greater part of whom were Indians. It has regular, spacious, and clean streets, with well built houses, generally of two stories. The principal buildings are the cathedral, in the Moresque style, the president's palace, the churches of San Miguel and San Francisco, two monasteries, three nunneries, and the theatre. It is the see of an archbishop.

**SUCRE, Antonio José de,** a South American soldier, born in Cumaná, Venezuela, in 1793, assassinated near Pasto, Ecuador, in June, 1830. He joined the insurrectionary army in 1811,

and was made brigadier general in 1819, and soon afterward commander of a division. In May, 1822, he won the victory of Pichincha, which was followed by the capitulation of Quito. In 1823 he led a Colombian army of 3,000 men to Lima, which he found in the hands of the royalists, and retired to Callao, where he was besieged several weeks till the successes of Gen. Santa Cruz compelled the royalists to evacuate Lima. In 1824 he succeeded Bolivar in command of the liberating army, and on Dec. 9 won the crowning victory of Ayacucho. (See Ayacucho.) In 1825 Bolivia was created into an independent republic, and on Aug. 11 the constitutional assembly appointed Sucre president. In an insurrection in 1827 he was attacked and severely wounded. In 1828 Gen. Gamarra forced him to quit Bolivia. He went to Colombia, was made commander of the Colombian army of the south, and conducted a successful series of operations, which terminated in the defeat and capitulation of the Peruvians under Gen. La Mar at Tarqui, Feb. 26, 1829. In 1830 he was a member of the constituent congress, and was returning to Quito from a session of that body when he was assassinated.

**SUDERMANIA.** See Södermanland.

**SUDETIC MOUNTAINS.** See Germany, vol. vii., p. 744.

**SUDORIFICS.** See Diaphoretics.

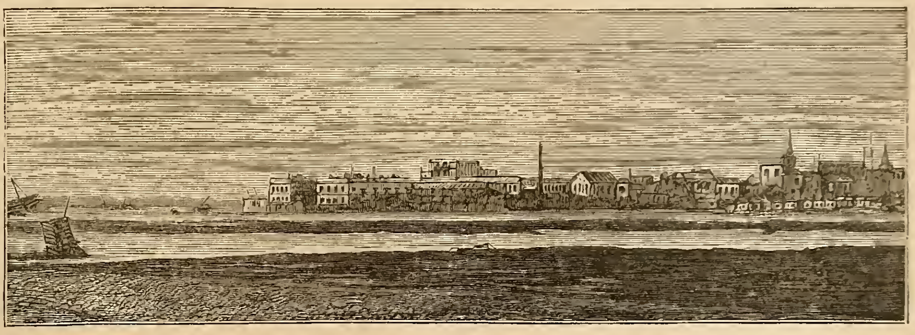
**SUE, Marie Joseph Eugène,** a French novelist, born in Paris, Dec. 10, 1804, died in Annecy, Aug. 3, 1857. He was an army and navy surgeon for several years till 1829, when he inherited a large fortune, and commenced writing maritime novels, of which *La Salamandre* (1832) attracted most attention. Under the patronage of the government he wrote *Histoire de la marine française au 17e siècle* (5 vols. 8vo, 1835–'7), which was a failure. In 1835 appeared *Cécile* and in 1841 *Mathilde*, two of his best novels, and in 1842 *Le morne au diable* and *Thérèse Dunoyer*. *Les mystères de Paris*, a work presenting terrible pictures of vice and corruption (10 vols., 1842–'3), and *Le Juif errant*, a merciless attack upon the Jesuits (10 vols., 1844–'5), had a prodigious circulation, and passed through many editions and translations. His other works include *Martin, l'enfant trouvé* (12 vols., 1847); *Les sept péchés capitaux* (16 vols., 1847–'9); and *Les mystères du peuple*, a narrative of the sufferings of a proletarian family through ages, which, after being continued serially from 1849 to 1856, was suppressed on account of its alleged immorality. He failed in 1848 as a candidate for the constituent assembly, but the socialistic tendencies of his most popular works gave him in 1850 a majority in a metropolitan district, and he was a silent member of the extreme left till the *coup d'état* of Dec. 2, 1851, which drove him from France. He afterward lived at Annecy, continuing his remarkable literary activity.

**SUETONIUS TRANQUILLUS, Caius,** a Roman historian, born about A. D. 72, died probably about 140. He was the son of a military tribune, and the younger Pliny helped him to become *magister epistolarum*. From this position he is said to have been removed by Hadrian about 121 in consequence of an indiscreet familiarity with the empress Sabina, though many historians entirely disbelieve the story, and give other causes for his dismissal. From the list of his works given by Suidas he must have been one of the most voluminous of Roman authors. His chief extant work is the *Vitæ XII Cæsarum*, in eight books, which abounds in details and anecdotes of a questionable character; besides which the treatises *De Illustribus Grammaticis* and *De Claris Rhetoribus*, and some brief biographies of Terence, Horace, Lucan, Juvenal, Persius, and Pliny the Elder, pass under his name. Fifteen editions of Suetonius's works had been published previous to 1500, of which the oldest with a date is that of Rome (fol., 1470). Among the best subsequent editions are those of Burmann (2 vols. 4to, Amsterdam, 1736) and Baumgarten-Crusius (Leipsic, 1816), revised by Hase (2 vols. 8vo, Paris, 1828), and newly edited by Roth (1858). All the fragments attributed to Suetonius have been published, with a critical commentary by Roth (1860). The first English translation was by Philemon Holland (fol., London, 1606), and the latest by Thomson and Forrester (Bohn's "Classical Library," 1855). On the sources from which Suetonius drew his facts, see Clason, *Tacitus und Sueton* (Breslau, 1871).

**SUEVI,** a powerful group of migratory German tribes, who about the beginning of the Christian era are said by ancient writers to have occupied the larger part of Germany. Cæsar describes them as dwelling between the Rhine and the Weser. According to Strabo, they extended across the central parts of modern Germany, between the Rhine and the Oder, and as far S. as the head waters of the Danube. Tacitus seems to designate by the name Suevi the tribes of eastern Germany from the Danube to the shores of the Baltic. In the 2d century the collective appellation disappears, the single tribes of the group being designated by their distinctive names. Later, however, other Suevi, an adventurous German people of mixed origin, appear upon the banks of the Neckar, where they gave rise to the modern name Swabia, and also in northern Spain, where they conquered Galicia early in the 5th century. Their Galician realm was destroyed by the Visigoths in 585.

**SUEZ. I.** An isthmus separating the Mediterranean and Red seas, and connecting the continents of Asia and Africa. From the most northerly part of the gulf of Suez in the Red sea to the gulf of Pelusium or Tineh in the Mediterranean the distance is a little more than 72 m.; on the line of the Suez canal it is about 100 m. The surface has a general elevation of only 5 to 8 ft. above the adjoining seas, but there are several ridges of from 20

to 65 ft., and a few depressions, lakes, and salt marshes which have become lakes since the construction of the canal. With the exception of places that have been made fertile by irrigation, it is a barren, sandy desert, uninhabited. Fresh water is found in but a few places. The surface soil is generally sand and gravel, underlaid with sandstone and varieties of limestone and conglomerate containing fossil remains and shells. It is probable that the whole isthmus was once under water, and that the Mediterranean and the Red sea were connected. Since the opening of the canal the climate has undergone a considerable amelioration, the temperature having become lower in summer and higher in winter. The change is attributed to the infiltration of water from the canal, and to the vegetation which has sprung up along its banks. (See CANAL.) **II.** A gulf forming the N. W. arm of the Red sea, lying between Egypt and the Sinai peninsula. It is about 180 m. long, and has an average breadth of 20 m. In ancient times it was called the Heroöpolite gulf. The Israelites are supposed to have crossed the Red sea on their exodus from Egypt a few miles below the head of the gulf. (See EXODUS, and RED SEA.) **III.** A town of Egypt, at the head of the gulf of Suez, 77 m. E. of Cairo; lat. 29° 57′ 30″ N., lon. 32° 35′ E.; pop. in 1872, 13,500, of whom 2,400 were foreigners. The old town is walled on the three landward sides, but open toward the sea. It stands on the border of a sandy plain where rain seldom falls, and previous to the opening of the fresh-water canal from the Nile in 1863 it depended for water on supplies brought from a distance. Suez was a mere fishing village until the building of the railway from Cairo, when it began to increase in size and importance; and the construction of the Suez canal, with its quays, docks, and other works, soon made it a large and busy place. The new quays and harbors, with the railway station and dry dock, are about 2 m. S. of the town, with which they are connected by railway. Among the principal buildings at Suez are the storehouses of the Peninsula and Oriental steamship company and of the *messageries maritimes*, the water works which supply the town from the fresh-water canal, the English hospital, and the chalet of the khedive on the heights overlooking the town and harbor. Suez is connected by railway with Cairo and Alexandria, but derives its principal importance from the Suez canal, of which it is the southern terminus. From the opening of the canal in November, 1869, to Dec. 31, 1874, 4,781 vessels, of 6,643,368 total tonnage, had passed through, of which 2,588 entered from the Mediterranean and 2,193 from the Red sea. Of the whole number, 3,286 were British, 394 French, 281 Austrian, 235 Italian, 121 Ottoman, 109 Dutch, 85 Egyptian, 83 German, 61 Spanish, and the remainder of other nationalities, only 8 being American. The number of passengers during the same period was 278,231, including 34,197 Moslem pilgrims and many troops of various nations. The total amount of tolls received during this time was 77,728,838 francs. In 1874, 1,264 vessels, of 2,421,803 gross tonnage, passed through the canal, of which 679 entered from the Mediterranean and 585 from the Red sea. The total receipts for tolls in 1874 were 24,748,900 francs. In November, 1875, all the shares of the Suez canal stock belonging to the khedive of Egypt, 177 out of 400, were purchased by the British government for £4,000,000. See *Lettres et documents pour servir à l'histoire du canal de Suez*, by Ferdinand de Lesseps (Paris, 1875).—Suez occupies probably the site of the ancient Clysma, the Kolzum of the Arabs. In the 8th century, after the destruction of the canal connecting with the Nile, it fell into decay. In the beginning of the 16th century it became a naval depot for the Turkish fleet in the Red sea, but soon lost its importance again with the decline of navigation in that sea in consequence of the discovery of the route to India by the cape of Good Hope.



Suez.

**SUFFOCATION.** See ASPHYXIA.

**SUFFOLK.** **I.** An E. county of Massachusetts, bordering on Massachusetts bay; area, about 44 sq. m. It comprises the cities of Boston and Chelsea and the towns of Revere and Winthrop. The population as returned

by the census of 1870 was 270,802; the subsequent annexation of the town of West Roxbury from Norfolk co. and the town of Brighton and city of Charlestown from Middlesex co. to Boston added 41,973 inhabitants, making the population within the present limits of Suffolk co. in 1870, 312,775; in 1875, according to the state census, 364,880. The number of manufacturing establishments, according to the census of 1870, was 2,546; number of hands employed, 43,550; amount of capital invested, $47,311,906; value of materials used during the year, $59,384,305; annual value of products, $111,380,840. Almost every variety of articles is produced. Capital, Boston, which is also the capital of the state. **II.** A S. E. county of New York, comprising the E. part of Long Island, bounded N. by Long Island sound and E. and S. by the Atlantic, drained by the Peconic river and several smaller streams, and traversed by the Long Island and other railroads; area, 1,200 sq. m.; pop. in 1875, 52,088. The surface is hilly and uneven in the north, but nearly level in the south; the soil is generally sandy, but fertile along the sound. The coast is indented by numerous harbors and inlets, and the county includes several small islands. The chief productions in 1870 were 184,564 bushels of wheat, 35,436 of rye, 515,099 of Indian corn, 322,069 of oats, 20,800 of buckwheat, 557,935 of potatoes, 43,006 tons of hay, 47,168 lbs. of wool, and 564,766 of butter. There were 7,112 horses, 9,269 milch cows, 9,704 other cattle, 14,412 sheep, and 12,624 swine; 6 manufactories of brick, 21 of carriages and wagons, 3 of cotton, 16 of fish oil, 3 of paper, 10 of saddlery and harness, 3 of sails, 12 flour mills, 1 woollen mill, and 19 ship yards. Capital, Riverhead.

**SUFFOLK**, a S. E. county of England, bordering on the counties of Norfolk, Cambridge, and Essex, and the North sea; area, 1,481 sq. m.; pop. in 1871, 348,479. The coast line extends about 50 m., and a great part of it is low and marshy. The principal streams are the Stour, Orwell, Lark, and Waveney; and there are several small lakes. The surface is undulating, with some flat and marshy tracts, and the soil is generally a rich alluvial loam. The manufactures, with the exception of agricultural implements, are trifling. Fishing is actively carried on. There are many remains of antiquity, including the Roman castle of Burgh, the walls of which are still standing. Suffolk contains two county towns, Ipswich and Bury St. Edmunds; other chief towns are Eye, Aldborough, Orford, and Sudbury.

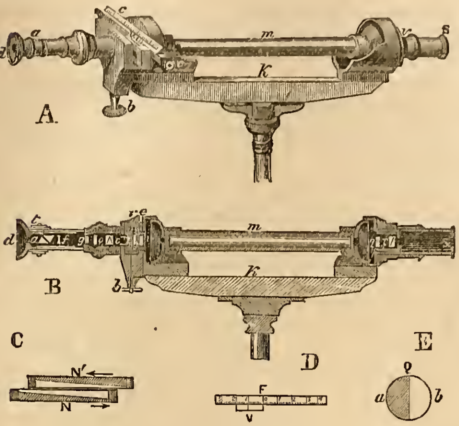
**SUFIS** (Arab. *suf*, wool, from the dress of the devotees), a peculiar sect of Mohammedans, who claim supernatural intercourse with the Supreme Being, a mystical identity and union with him, and miraculous powers. Said Abul Khair first gathered them into an organized body about 820, and they have numbered among them some of the most eminent Mohammedan scholars and poets.

**SUGAR**, a name used in nearly all languages, in various forms, to designate a limited number of sweet products of plants, which is made by the chemist to include several organic compounds, many of which may be artificially produced from similarly constituted organic bodies. Sugars are therefore divided into natural and artificial. In general terms they are now included among a group of compounds called hexatomic alcohols. Two of the natural sugars, mannite and dulcite, having the composition $C_6H_{14}O_6$, are saturated hexatomic alcohols, derived from the saturated hydrocarbon $C_6H_{14}$. Several others, called glucoses, have the formula $C_6H_{12}O_6$, and may be regarded as aldehydes of these alcohols. It may be remarked that ordinary glucose or grape sugar is converted into mannite by the action of nascent hydrogen, just as acetic aldehyde, $C_2H_4O$, is converted into common alcohol, $C_2H_6O$. There are also diglucosic alcohols, $C_{12}H_{22}O_{11}$, the most important of which are cane sugar and milk sugar.—Mannite, $C_6H_{14}O_6$, is the chief component of manna, an exudation from a species of ash. It is also found in several sea weeds and in mushrooms. It may be prepared by dissolving manna in boiling alcohol and filtering while hot. It crystallizes on cooling in tufts of slender, needle-like, four-sided prisms. It may be formed artificially by the action of sodium amalgam on glucose, the latter taking up two atoms of hydrogen. By oxidation with nitric acid mannite is converted into saccharic acid, $C_6H_{10}O_8$, and ultimately oxalic acid. The boiling point is 329° F. Dulcite, or dulcose, having the same formula, is obtained from a crystalline substance of unknown origin, imported from Madagascar, by boiling water. Crystals belonging to the monoclinic system form on cooling the solution. It thus differs from mannite, the crystals of which are trimetric, and also in its boiling point, which is 360°.—The glucoses are a group of sugars having the common formula $C_6H_{12}O_6$, and consisting, as far as known, of eight members: 1. Ordinary glucose or dextro-glucose, so named from its power of rotating a ray of polarized light to the right, is made by hydration of starch by the action of dilute acids or of diastase. It is found in honey and various fruits, especially grapes, and therefore also called grape sugar. (See FERMENTATION.) Its rotatory power is +56° at all temperatures. 2. Maltose is produced by the limited action of diastase on starch, and differs from ordinary glucose only in its power of rotating a ray of polarized light, having a dextro-rotatory power three times as great as that of ordinary glucose. It is converted into ordinary glucose by boiling with dilute acids. 3. Lævulose is isomeric with the others, but distinguished from them by turning the plane of polarization to the left. It also, unlike other sugars, has its rotatory power changed by varying the temperature, the power diminishing with increase of temperature, being −106°

at 57° F., —79·5° at 125·5° F., and —53° at 194° F. It occurs, associated with dextro-glucose, in honey and many fruits. A mixture of lævulose and dextro-glucose constitutes fruit sugar, fructose, or invert sugar, which is also lævo-rotatory, because the specific rotatory power of lævulose at ordinary temperature is greater than that of dextro-glucose. 4. Mannitose, produced by the oxidation of mannite, is uncrystallizable and fermentable, but has no action on polarized light. 5. Galactose, formed by the action of acids on milk sugar, crystallizes more readily than ordinary glucose, has a dextro-rotatory power of 83·3°, and is easily fermentable. 6. Inosite occurs in the muscular substance of the heart and other organs of the animal body, in green kidney beans, and in other plants. It forms prisms resembling gypsum, soluble in water, but insoluble in alcohol and ether. It does not ferment with yeast, but in contact with cheese, decaying flesh, or membrane, with chalk, it undergoes lactous fermentation, producing lactic, butyric, and carbonic acids. It has no optical rotatory power. 7. Sorbine occurs in the juice of the mountain ash berry. The juice on standing deposits brown crystalline matter, which by recrystallization forms crystals belonging to the trimetric system. It dissolves easily in water, and has a very sweet taste. It is converted by hot nitric acid into oxalic acid, and does not ferment with yeast, but like inosite undergoes lactous fermentation. It has a rotatory power of about −47°. 8. Eucalyne is found with other kinds of sugar in the so-called Australian manna, which falls in opaque drops from various species of eucalyptus. Its optical rotatory power is about +50°.—Besides these glucoses, there are sugars which may be regarded as formed by the combination of two or more molecules of glucose with the elimination of a number of molecules of water. These sugars have been called polyglucosic alcohols, having the formula $C_{12}H_{22}O_{11}$. 1. The most important member, as well as the most important of all the sugars, is cane sugar, or saccharose, which is found in the juice of many of the grasses and the sap of several forest trees, particularly the hard maple, in the roots of the beet, parsnip, mallow, and several other plants, and in most sweet fruits, associated with lævulose and dextro-glucose (currant sugar, fructose). Walnuts, hazelnuts, and almonds contain only cane sugar. Honey and the nectaries of flowers contain cane sugar together with invert sugar. Pure cane sugar separates from a solution by slow evaporation in large transparent colorless crystals, having the figure of a modified monoclinic prism. From hot saturated solutions it is obtained in masses of smaller crystals (loaf sugar). Its optical rotatory power is +73·8°; its sp. gr. 1·6, unchangeable in the air. When heated a little above 320° it is converted, without loss of weight, into a mixture of dextro-glucose and lævolusan, the anhydride of lævulose ($C_{12}H_{22}O_{11} = C_6H_{12}O_6 + C_6H_{10}O_5$ or lævolusan). It changes with loss of water into other substances as the temperature rises, until at 410° a brown substance called caramel is formed, which consists of a mixture of several compounds, all resulting from the elimination of the elements of water from sugar. As the temperature rises gases are evolved, consisting of carbonic oxide, marsh gas, and carbonic acid, and a distillate is obtained consisting of brown oils, acetic acid, acetone, and aldehyde, a quantity of charcoal remaining in the retort. By prolonged boiling with water, cane sugar is converted into invert sugar, the transformation being accelerated by the presence of acids, especially sulphuric. It is not directly fermentable, but by the action of yeast is resolved into dextrose and lævulose, which then enter into fermentation. It is a reducing agent, capable of readily taking the oxygen from several oxides and metallic salts. It forms with chlorate of potassium a mixture which detonates on percussion, and burns vividly in contact with oil of vitriol. It is distinguished from glucose by not turning brown when triturated with alkalies; but it combines with the alkalies, forming compounds called sucrates. 2. Parasaccharose, $C_{12}H_{22}O_{11}$, is produced by the spontaneous fermentation of a solution of cane sugar containing ammonium phosphate. Its rotatory power is +108°. 3. Melitose, $C_{12}H_{22}O_{11}$, is found in the Australian manna, associated with mannitose. The crystals which are deposited from the aqueous solution are hydrated, the formula being $C_{12}H_{22}O_{11} + 3H_2O$. At 212° F. they give off two molecules of water, and at 286° become anhydrous. Its rotatory power is +102°. Melitose ferments by the action of yeast, but is first resolved into glucose and eucalyne. 4. Melezitose, $C_{12}H_{22}O_{11}$, is a kind of sugar found in the so-called manna of Briançon, which exudes from the young shoots of the larch. It is not as easily acted on by reagents as the foregoing. Its rotatory power is about +94°. 5. Trehalose, $C_{12}H_{22}O_{11}$, $2H_2O$, is obtained from trehala manna, the produce of a species of *echinops* growing in the East. It forms rhombic crystals, which when heated below 212° F. slowly give off their molecules of water. Its rotatory power is +199°. With strong nitric acid it forms a detonating nitro-compound. It is not readily acted on by reagents. 6. Mycose, isomeric with trehalose, and also containing two molecules of water, is obtained from the ergot of rye by precipitating the aqueous extract of the fungus with basic acetate of lead, removing the lead from the filtrate by hydrosulphuric acid, evaporating to a sirup, and leaving the liquid to crystallize. Its rotatory power is +192·5°. 7. Milk sugar, or lactose, contains one molecule of water, the formula being $C_{12}H_{22}O_{11} + H_2O$. It is an important constituent of milk, and is obtained by evaporating the whey to a sirup, from which

on standing it separates in impure crystals, and may be purified by redissolving in water and filtering through animal charcoal. It forms white, translucent, four-sided, trimetric prisms of great hardness. It dissolves slowly in cold water, requiring five or six times its weight. Its optical rotatory power is $+59\cdot3°$. Very strong nitric acid converts milk sugar into nitro-lactine. It is brought very slowly into alcoholic fermentation by the action of yeast, but when cheese or rennet is used it is readily converted into lactic acid, alcohol being formed at the same time. A kind of sugar called glycyrrhizine or liquorice sugar, having the formula $C_{24}H_{36}O_9$, is found in liquorice root (*glycyrrhiza*). It has a peculiar sweet taste, but cannot be made to ferment. According to Gorup-Besanez, when boiled with dilute acids, it splits up into a resinous body called glycyrretine, $C_{18}H_{26}O_4$, and glucose.—*Saccharimetry.* There are various methods of estimating the proportion of sugar in a given solution, which are embraced under the generic term saccharimetry. They are usually employed for the estimation of cane sugar. There are four principal methods: 1, by the specific gravity of the solution; 2, by the amount of carbonic anhydride or of alcohol it will yield in fermentation; 3, by the amount of suboxide of copper precipitable from a solution by the action of grape sugar, into which the cane sugar present is first converted; 4, by the degree of rotation given to a beam of polarized light in passing through the solution. In the first and fourth methods instruments called saccharometers are employed, the term saccharimeter being often applied to the polarizing instrument. The specific gravity or hydrometric saccharometer is used by brewers for determining the amount of saccharine matter which has been produced in wort by the fermentation of malt. (See BREWING, and HYDROMETER.) The instrument is also employed by sugar makers and distillers. The brewer's saccharometer is usually graduated so as to indicate the excess of weight of 1,000 parts of a liquid by volume over that of the same volume of distilled water. For this purpose the hydrometer is marked 1000 upon its stem at the point to which it sinks in water, and with increasing numbers below this point. If the tested solution is dense enough to float the instrument till the number 1065 is at the surface, it is said to have a specific gravity of 65; if only to 1020, its gravity is said to be 20. Tables are used by which the quantity of sugar may be estimated from the specific gravity thus ascertained, and the tables may be adapted to differently graduated instruments, but the one above described (Baumé's) is usually employed. As beer wort holds other substances besides sugar in solution, the method is not exact, but in experienced hands it answers all the purposes of the brewer. When the solution is purely saccharine, or nearly so, as in clarified cane juice, the process is more nearly accurate; but when other substances are present the precise amount of sugar may be determined by the second method, that of producing fermentation and estimating the quantity of carbonic anhydride or of alcohol which is thereby formed. The third method, that by precipitation of suboxide of copper from an alkaline solution of tartrate of copper and potash, is briefly as follows: A standard solution, known as Fehling's, is prepared with 1 oz. of crystallized sulphate of copper, 3 oz. of bitartrate of potash, $\frac{1}{2}$ oz. of pure carbonate of potash, and 14 or 16 oz. of a solution of caustic potash of sp. gr. 1·12, with sufficient water to make the solution weigh 15,160 grs.; 200 grs. of this solution contain an amount of copper which is completely precipitated by 1 gr. of grape sugar. In using Fehling's solution a temperature approaching the boiling point should be maintained, and the saccharine solution should be slowly added from a graduated burette. It is necessary before testing to convert the cane sugar into glucose, which is done by adding sulphuric acid and boiling. The method by polarized light is performed by employing an instrument first devised by Biot, but since modified and improved by Soleil. In the article LIGHT, vol. x., pp. 449, 450, it is shown that several substances have the property of rotating the plane of a polarized ray, some to the right and some to the left, and also that substances having the same chemical composition may rotate the ray in both directions. A solution of dextrose (grape sugar or glucose) has the property of right-handed rotation, while lævulose, having the same chemical composition ($C_6H_{12}O_6$), turns the plane of polarization to the left. Quartz also, by reason of a difference in its molecular structure, is in some specimens right-handed and in others left-handed in its power of rotation. The original apparatus devised by Biot employed a tube containing the solution of sugar to be examined, the depth of the liquid producing a certain degree of rotation indicating the proportion of glucose it contained, and therefore the amount of cane sugar, this being first converted into glucose. The saccharimeter devised by M. Soleil does not measure the degree of rotation produced directly, as in Biot's instrument, but employs the principle of compensation, and furthermore employs a comparison of color, using therefore white instead of homogeneous light. The amount of compensation is measured by an attachment called a compensator, which is made of two wedge-shaped pieces of quartz whose combined thickness may be varied by sliding them over each other. A copper tube, *m*, figs. A and B, tinned on the inside and containing the solution to be tested, is closed at both ends by two glass plates, and rests upon the support *k*, which also bears at its ends the tubes *a* and *r*. These tubes contain the analyzers and polarizers, which are represented in section at B. The light of a com-

mon lamp is passed through the aperture S and the double-refracting prism $r$, the polarizer which transmits the ordinary ray, the extraordinary being thrown out of the field of vision. (See LIGHT, vol. x., pp. 445, 446.) The prism is so placed that the plane of polarization is in the axis of the instrument and also vertical. After passing through the double-refracting prism the polarized ray meets a refracting plate $q$, shown in section at E, composed of two pieces of quartz placed side by side, one having right-handed and the other left-handed polarizing powers. These plates are each 3·75 millimetres thick, producing a rotation of 90° and a rose-violet tint, called the transition tint. These two quartz plates, having equal powers of rotation, turn the ray in opposite directions, and therefore when viewed through a double-refracting prism they appear of the same tint when the plane of the ray is perpendicular; but if it has been turned by passing through a rotating solution, a difference of tint will be produced. After passing through the double quartz plate $q$, the ray traverses the solution in the tube $m$, and a single quartz plate $i$, fig. B, of any thickness and either right-handed or left-handed. The compensator $n$, composed of two wedge-shaped pieces of quartz, shown in section at C, both either right-handed or left-handed, but of opposite rotation to the plate $i$, is next traversed by the ray. This compensator can be varied in thickness and therefore in rotating power so as to balance exactly the degree of rotation produced by the solution. Its thickness is regulated by means of a rackwork and pinion turned by the milled head screw $b$, figs. A and B. A scale and vernier shown at D is affixed to the plates, by which the thickness of the compensation may be read, the vernier pointing to zero when the thickness of the two plates is equal to that of $i$. A double-refracting prism $c$, fig. B, is placed next behind the compensator to act as an analyzer which has been



Soleil's Saccharimeter.

acted upon by the solution and the various plates. When the liquid in the tube is inactive and the compensator is not at zero, the plate $i$ and the compensator will neutralize each other's effect, and the two parts of the double quartz $q$ will have the same tint; but when the tube $m$ contains a solution having a rotatory power, like sugar, this power added to that of one of the plates will rotate the plane of polarization of the transmitted ray either to the right or to the left. If the solution contains cane sugar or dextrose, or a certain excess of either, it will rotate it to the right; if it contains lævulose or a certain excess, it will rotate it to the left, and therefore a difference in tint will be observed in the two halves of the double quartz plate $q$, one half perhaps being red and the other blue. The thickness of the compensator is then adjusted by turning the milled head $b$ until the tints become the same, and the increase or decrease in the thickness of the two plates will indicate the rotatory power of the solution, either right-handed or left-handed, and may be read upon the scale. The following standard of comparison is employed: If 16·471 grs. of pure cane sugar is dissolved in sufficient water to make 100 cubic centimetres, this solution placed in a tube 20 centimetres long will produce the same degree of rotation as a right-handed quartz plate one millimetre thick. Or if a tube exactly 37·65 in. long is filled with a solution containing 10 per cent. of pure cane sugar (crystallized sugar candy), and a polarized ray from the middle of the yellow band of the spectrum is passed through it, the rotation of the plane will be 73·8°. This, compared to the rotation produced by a solution of pure cane sugar of a different strength, will show the relative proportion it contains; or if the depth of the solution is less, the rotation will be less in the same proportion. If the solution contains left-handed sugar, the result will be vitiated and corrections have to be made. This may be done by converting all the sugar into left-handed sugar by the action of hydrochloric acid, and making a second observation, when by a comparison of the results obtained at both observations the amount of cane sugar may be estimated. The optical rotatory power of the various sugars mentioned in this article has been determined according to the standard of comparison here given. The arrangement of prisms and lenses placed behind the double-refracting prism $c$ forms what M. Soleil calls the producer of sensible tints. The particular tint which allows the most delicate difference in the color of the two halves of the double quartz to be distinguished is not the same for all eyes. This effect is produced by placing in front of the prism $c$ a quartz plate $o$ cut perpendicular to the axis, then a small Galilean telescope, consisting of a double convex lens $g$ and a double concave lens $f$, with adjustable focal distance. The double-refracting prism $c$ acts as polarizer to the quartz $o$, while the prism $a$ is the analyzer, and on being

turned to the right or left may be made to produce that tint to which the eye of the observer is the most sensitive.—*Sugar Cane.* Commercial cane sugar is made from species of *saccharum*, especially *S. officinarum*, a genus of grasses of the tribe *andropogoneæ*, of which subdivision the cultivated sorghum and broom corn are familiar examples. Sugar cane is a perennial grass, with solid stems from 6 to 20 ft. high, the older plants throwing up numerous stems or suckers from the root; the leaves, 3 ft. or more long and 3 in. broad, have thin sheaths, usually glaucous with a bloom or waxy exudation, which is also found upon the stem, especially in the dark-colored varieties; the flowers are in a large, ample, and showy panicle, about 2 ft. long, the ultimate branches of which are notched or jointed, bearing at each joint two flowers, one of which is sessile and neutral, the other on a short pedicel and perfect; both kinds of flowers are surrounded

Sugar Cane (Saccharum officinale).

by a tuft of long hairs, which gives the cluster a soft silvery appearance. The sap or juice of the plant contains from 15 to 20 per cent. of sugar. It has not been found in the wild state in any part of the world; and while there is much doubt as to its native country, the most careful investigations point to Bengal as the origin of *S. officinarum*, and it was there that the manufacture of sugar commenced. If, as botanists are disposed to admit, the sugar cane of China is a distinct species (*S. Sinense*), it would appear that the cultivation of related plants for the extraction of sugar was undertaken separately in two distinct and widely separated countries. While the product was anciently referred to as "honey of canes," and by other names, sugar as we know it is not mentioned before the commencement of the present era. Dioscorides, about A. D. 100, mentions *saccharon.* In the 9th century the cultivation had extended to Persia, and in the 10th and 11th centuries Avicenna and other eastern physicians used sugar in medicine. Its cultivation was carried on in Spain in the 10th century, at which time sugar was an article of trade, especially by the Venetians, through whom the English received their supply. The cane was introduced into Madeira in 1420, and some time after into the Canaries. With the discovery of America, its distribution was very rapid, Santo Domingo, Brazil, Mexico, Guadeloupe, and other countries undertaking its culture in quick succession. Meanwhile it spread to Africa and the Indian archipelago. In 1852 it was taken to New South Wales; it had long previously been cultivated in most of the islands of the Pacific. Several early writers mention the sugar cane as one of the indigenous products of the United States, and it was said to grow in Virginia and in Louisiana; of course some other large grass was mistaken for the sugar cane; both the common reed (*phragmites*) and the southern cane (*arundinaria*) have a sufficiently near resemblance to sugar cane to lead a careless observer into this error. The plant appears to have been cultivated in this country for the first time about 1751, near the site of New Orleans, by some Jesuits from Santo Domingo. In 1758 the first sugar mill was built, a little further down the river, by M. Dubreuil. According to a statement of E. J. Forstall in De Bow's "Industrial Resources," vol. iii., p. 275, the manufacture of cane into sugar does not seem to have commenced before 1764; but sugar is said to have been one of the staple products of the colony in 1770. After the revolutionary war it was prosecuted so successfully by emigrants from the United States that in 1803 there were 81 sugar estates on the Mississippi delta alone. The cession of Louisiana to Spain seems to have arrested the industry, as no accounts of sugar making are found until 1791, when the first sugar house under the Spanish government was erected by a Mr. Solis at Terre aux Bœufs, in the parish of St. Bernard. The next was established in 1796 on a plantation where now stands Carrollton. The success of this enterprise was the foundation of the sugar culture in Louisiana. In 1818 the production was 25,000 hogsheads, and the cane was ground altogether by cattle, steam power not being introduced till 1822. The sugar-growing district in Louisiana is on both sides of the Mississippi, from 57 m. below New Orleans to nearly 190 m. above; on the Red river and its tributaries; and on many of the bayous. But even Louisiana is rather too far north to allow of the perfect ripening of the plant, which is sometimes killed by the frost in the spring, and also injured in October and November. In Texas the crop is important, and cane is grown to a considerable extent in several of the other gulf states, especially in Florida, and to a limited extent in South Carolina, Tennessee, and Kentucky. In the more northern localities it is profitably cultivated mainly for

the manufacture of sirup.—It is not definitely settled whether the sugar cane from China (*S. Sinense*) is really a distinct species, but all others formerly so regarded are now considered as only forms of *S. saccharatum*, of which each sugar-growing country has several varieties. The country or creole cane, the kind first introduced into the West Indies and Louisiana, and regarded as the original form of the species, was at one time much esteemed, but has greatly deteriorated. The ribbon cane, so called from the yellow and purple stripes upon the stem, is inferior to the following varieties. The Otaheite or Bourbon cane was introduced into Georgia in 1805, and is also a favorite variety in some parts of the West Indies, its stem being thicker than that of the others. It has been supposed that this was a native of Otaheite or Tahiti. The violet or Batavian cane has a purple stem, varying in depth of color with the nature of the soil; its leaves are luxuriant and of a dark green color, and the flowers are purplish; it has been described as a distinct species, *S. violaceum*, but there is nothing to warrant its separation from the ordinary cane. Besides these leading varieties, there are the claret, imperial, Mont Blanc, and others, with numerous local subvarieties. The dark-colored canes are found to resist the attacks of disease much better than the light-colored ones, a peculiarity of which there are numerous other illustrations among plants and animals.—In none of the sugar-producing countries does the sugar cane ever perfect seeds, and it is quoted as an illustration of the fact that plants which have long been propagated by other methods lose the power of producing seeds. The cane is always propagated by cuttings, and as the lower portion of the stem is the richest in sugar, the upper and comparatively worthless portions are used for cuttings, a practice to which the deterioration of varieties is ascribed. The details of cultivation vary in different countries; in the cooler cane regions there is a season when growth must cease, while in others it is continuous; in some prolonged rains modify the culture, and in others irrigation must supply the needed moisture. But wherever it is grown, it must have a fertile soil; it is a plant which quickly exhausts the soil, and unless manure is used, the land is fallowed, or the crop forms part of a rotation, the soil is soon run down. In some sugar-growing countries the ground is prepared by penning cattle upon the fields; in others some crop is grown which, with the weeds, is turned under; and in the British West Indies fertilizers of various kinds are used. The distance between the rows varies from 2½ to 8 ft., the latter distance giving a better crop than closer rows. In the best culture the land is well ploughed, and then thrown up into ridges with the plough, at the desired distance apart; a trench, 3 in. or more deep, is opened upon the top of the ridge, in which the cuttings, about 2 ft. long, are laid in a single and sometimes a double row; the cane is then covered by hoes, or by a cane coverer drawn by horses, which will cover 10 acres in a day. After the shoots appear they are kept clear of weeds until they shade the ground, and prevent all other growth. In dry countries it is customary to "trash" the cane when it gains a sufficient size; the lower leaves are broken off and laid upon the earth to prevent evaporation. The shoots produced the first year from the cuttings are called "plant canes;" it is known to have attained its full growth by "arrowing;" the lower joints are usually about 3 in. long, but above they increase in length while they diminish in diameter and are much less rich in sugar, until finally a long joint (in tropical countries 6 or 8 ft. long) shoots up, which if permitted would bear the flower cluster; this shoot is termed the "arrow," and its appearance indicates that the cane should be topped, or cut up at once, else the accumulated sugar in the juices of the plant would be expended in the production of flowers. In climates where the season is short the cane does not arrow, and the time for cutting is governed by the probable appearance of frost. In Louisiana it begins to ripen at the bottom in August; as each joint ripens the leaf belonging to it withers, and when it is time to harvest the upper part of the cane is cut back to a joint upon which the leaf is dry, and the crop is cut off close to the ground; if frost is apprehended, the cane is "mattressed," the product of three rows being so laid together that the leaves of one armful will cover the buts of the preceding; being thus thatched, the canes are protected from frost and will keep in this state for several weeks without injury. The second year after planting numerous shoots start up from the old plants; these are called "rattoons" (Fr. *rejetons*), and the crop is thereafter a rattoon crop, the value of which, though less than that of the plant cane, depends upon the original fertility of the soil, or the manner in which this has been maintained. In Louisiana but one or two rattoon crops are taken, requiring a replanting every second or third year; while in some of the West Indies the plantation lasts from six to ten years, and in the East even longer; but when thus long continued, the yield is small and the impoverishment of the soil correspondingly great. —*Manufacture of Cane Sugar.* As soon as the canes are cut they are ground in a mill. There are many forms of mills, and those in use in the East Indies from the earliest times are exceedingly rude, slow, and inefficient, and very rude mills are still used by small planters in the West Indies; but powerful mills driven by steam are employed upon the larger estates, the crushing apparatus usually consisting of three heavy cast-iron rollers. The canes are usually passed twice through the mill. About two thirds of all the juice is extracted, and the crude liquor contains, besides sugar, woody fibre, soluble salts, albumen,

caseine, wax, &c. In the hot climate of the sugar plantations the juice if left to itself begins to ferment in the course of an hour; it is therefore immediately treated with from $\frac{1}{3000}$ to $\frac{1}{800}$ of its weight of lime, and heated to 140° in large flat-bottomed copper pans or clarifiers holding from 300 to 400 gallons each. This coagulates the albuminous portions, which rise to the surface as scum. Some planters treat the juice with sulphurous acid, by which fermentation is delayed. The clear liquid, after cooling for an hour or two, is drawn off for concentration by boiling. The fuel used is usually the dried crushed canes, the ashes of which are returned to the soil. By the old method practised in Asia a series of 11 kettles or earthen boilers is set in a line in a rudely constructed range, at one end of which is the fire, with a large iron boiler over it, and at the other the chimney. The juice is first put into the boiler furthest from the fire, and is gradually transferred to the others, as the process goes on, until the final concentration is effected in the iron boiler. The product is afterward drained and the sugar is clarified by boiling again with water, an alkaline lye, and milk. A somewhat similar arrangement of kettles, to the number of four, five, or six, has been employed in this country and the West Indies, each kettle having its own fire, and the defecation or partial purifying being effected during the boiling by "tempering" the liquor with slaked lime. This, when used in small quantity, causes the glutinous matters present to coagulate and rise upon the surface in a scum, which may be continually removed by skimming. It also neutralizes any acid that may have formed. In Louisiana it has been the practice to concentrate the sirup to 42° Baumé in the last kettle, called the battery, and then transfer it to large wooden vats, called coolers, for granulation; but the operations have been variously modified there, and different methods too have been pursued in the West Indies. Instead of kettles, each one requiring a separate fire, large copper caldrons are heated by steam, either by being enclosed in a steam jacket or by containing a coil of steam pipe. The clarification is effected as before by means of lime added to the sirup diffused through a portion of juice, or in the form of milk of lime of known strength and carefully graduated, so that exact quantities may be used. Just enough should be used to neutralize exactly the sirup, which may be known when litmus paper indicates neither an acid nor alkaline reaction. An excess of lime should be particularly guarded against, as it involves a loss of sugar; and when it occurs the effect should be corrected by careful addition of alum, or better of sulphate of alumina, which contains no potash. The heat employed in clarifying should not reach the boiling point of the sirup. At a less degree a scum gathers upon the surface, and when this breaks up into white froth, the clarification is completed. The heat is then stopped, and the liquor is left to repose for an hour, when it is drawn away from the scum, and is seen as it flows into the first of the evaporating pans to be of a clear bright wine-yellow color. These pans, to the number of three or more, are set in succession over a flue heated by a fire at one end. The liquor is gradually transferred to the smaller pans, and as it boils away the scum that rises is taken off. It is the skimmings in these operations that furnish the best materials for distillation, and the manufacture of rum is very generally carried on in connection with that of sugar. In the smallest and last pan, to which sometimes the term "teache" is exclusively applied, the sirup is finally collected; and when it is judged to be sufficiently concentrated for granulating, it is transferred into the coolers, and thence into the vessels, also called coolers, in which the granulating takes place. These are of wood with thick sides, about 7 ft. in length, 5 or 6 ft. in width, and not less than a foot deep. This depth and the thick sides are requisite to secure slow cooling, without which the grains could not be coarse. In about 24 hours the graining takes place, the crystals forming a soft mass in the midst of the liquid portion or molasses. The separation of the two products is effected by drainage in what is called the curing house. This is a large building covering an open reservoir. Frames are provided for hogsheads so that the drippings from these shall flow into the reservoir. In the bottom of each hogshead several holes are bored, and into each hole is put a crushed cane or the stalk of a plantain leaf, the lower end projecting several inches below the bottom. The hogsheads being filled with the soft sugary mixture, the molasses gradually drains away from it, dripping from the stalks. The operation goes on for three to six weeks, till the sugar is considered sufficiently dry for shipping. It still retains considerable molasses, and in the moist hold of the ship the separation continues, the molasses leaking away and involving a serious loss. The "Julius Robert diffusion process" for extracting sugar from cane is in use at the sugar establishment of Messrs. Koch, in Bayou Lafourche, Louisiana. A series of tall cylinders connected by pipes are filled with thinly sliced canes and water. The diffusion allows the hydraulic pressure to carry off the dissolved sugar. The water is heated by steam to about 190° by a boiler through which the diffusion juice passes. It is said that a much greater proportion of the sugar is extracted by this method, and that the clarifying process is much simplified and abridged.—*Sugar Refining.* The preparation of the purest varieties of sugar did not originate in the sugar-producing countries, but the art was applied first by the Venetians to the crude sugars brought from Egypt. It was practised in Antwerp in the 16th century, and was thence introduced into England. At present it is an important branch of manufacture

in most of the principal commercial cities of the United States and of Europe. As formerly practised, raw sugar was dissolved with lime water in a large open boiler, and, when warm, bullock's blood was added, which as it coagulated on boiling collected most of the lighter impurities and carried them to the surface in the form of a thick scum. This being removed, the liquor was partially evaporated by boiling, filtered through woollen cloth, then concentrated and grained on the general plan already described. The best sugar refiners do not now use blood or any other coagulating substance to collect suspended matters, but separate them entirely by filtration. The process in the best establishments is substantially as follows: On the ground floor the raw sugar is dissolved in hot water in large cisterns. Water enough is added to produce a specific gravity of about 1·25, or 29° Baumé. By a large pump near each cistern at the same level the solution is drawn off through a connecting pipe provided with a coarse wire strainer, which prevents all except the smaller solid particles from entering the pump. The saccharine solution is pumped up into the highest story, which is usually the seventh or eighth, it being cheaper as well as more convenient to elevate the sugar in solution than in a solid state. It is pumped into vessels called "blow-up pans," because steam was formerly blown into them to heat them. They are now heated with close coils to about 208° or 210° F. Milk of lime is added to the solution in these pans for the purpose of neutralizing any acid which it may contain. From these pans the sirup passes down to the next floor and into filters by which it is completely deprived of all suspended solid particles. These filters consist of a great number of bags 4 or 5 in. in diameter and 8 or 10 ft. long, made of two thicknesses of cloth, an outer of coarse and an inner of fine material. They are enclosed in sets of about 200, in boxes, to prevent cooling. After a time they become foul, when they are turned inside out and washed. After leaving the bag filters, which it does at a temperature of from 170° to 180°, the sirup is run through filters of animal charcoal or bone black. These are immense cylinders, 6 or 8 ft. in diameter and usually from 20 to 25 ft. high, filled with pulverized bone black, which substance has the property of absorbing all the coloring matter in the sirup, which runs from the bag filters of a sherry wine color. After a time the charcoal becomes foul and loses its property of absorbing coloring matter, when it is taken to a neighboring room and reburned in kilns. The sirup which runs from the charcoal filters at a temperature of about 150°, and, in a perfectly colorless condition, is now pumped into vacuum pans and concentrated to the granulating or crystallizing point. These vacuum pans were invented by Howard and patented in 1812. They are large conical or ovoid vessels heated by steam and exhausted with air pumps, by which the air and vapor are rapidly removed. In the later stages of the process the pressure is reduced to only 3 in. or less of mercury. The pans are sometimes supplied with an apparatus for condensing the steam by a cold spray. In making hard sugars, at the commencement the evaporation is conducted at a temperature of 170° to 180° F., but as soon as granulation begins it is lowered to 160°, and just before the evaporation is completed it is reduced to 140°, this being the lowest temperature at which crystallizing sugar boils at a pressure of 3 in. of mercury. An ingeniously devised sliding tube, by which a "proof" may be taken without admitting air, is attached to the vacuum pan. In making soft sugar the temperature is kept rather lower. As soon as crystallization begins the sugar is run off, and if it is to be made into soft sugar, the sirup is discharged by means of centrifugal mills. If it is for hard sugar, it is run into a vat which has a gate in its bottom; from this it is run into conical moulds placed upon carriages, which are drawn under the gate. In the bottom of each mould there is an orifice which is kept closed by a stopper for several hours, until the sugar crystallizes, when it is removed and the sirup allowed to drain away. The loaf which remains has a slight yellow tint, which is removed by allowing a colorless solution of sugar to pass through it. The loaves are then taken out of the moulds and dried in ovens at a temperature of about 160°. The sirup which drains from the moulds still contains a small percentage of cane sugar, but too small to recover with profit. It is therefore sold as sirup. It may be here remarked that raw molasses contains enough cane sugar to make it profitable for some establishments to make a specialty of extracting it. The muscovado molasses from Cuba, Porto Rico, and Antigua is esteemed the best.—*Beet Sugar*. In 1747 Marggraf, a Berlin chemist, found that the white beet yielded 6·2 per cent. and the red beet 4·6 per cent. of sugar, but the manufacture was not developed till the close of the year 1800. (See Beet.) The beets preferred in Europe for the manufacture of sugar are varieties of the white Silesian, yielding a juice richer in sugar and more free from salts than that of other kinds of beet. The weight of the larger ones is about 5 lbs. each; and the yield per acre in France and Belgium is 14 or 15 tons, and about Magdeburg 10 to 12 tons of beets. The crop is successful over the greater part of Europe, but more particularly N. of lat. 45°, and upon light dry soils, in a dry atmosphere. The richness of the juice is injured by direct application of manures to the growing crop, and it is less in large beets than in small ones. When the leaves begin to die, the beets are dug, the heads cut off, and the roots are thrown together and covered to protect them from light and frost. They may be thus kept for some time, though there is always risk of portions of the sugar passing

into the uncrystallizable variety. The proportion of sugar contained in the fresh root varies from 5 to 12 per cent., and the product in a large way is usually about 6 per cent., sometimes 7½. The other contents of the root are: water, 83 to 94 per cent.; ligneous fibre and albumen, 2·5 to 5 per cent.; together with a small proportion of what is supposed to be pectine, and a trace of mineral substances. In the factory the beets are first washed clean in a cage revolving on a horizontal axis, and partly immersed in water; and when washed they are discharged by the action of the machine itself. As the juice cannot be forced out from the cells by compression alone, it is found necessary to tear open the cellular tissue, and this is done by a grating machine of the form of a rotating drum, the inner surface of which is studded with teeth. The pulp is then subjected to powerful hydraulic pressure. Maceration has also been employed to separate the juice. For this purpose the beets are cut into thin slices and put into a cistern with about their own bulk of hot water. In half an hour the liquor is let down upon other slices in another cistern, and so on through three to five vessels, until it acquires a density of 5½° to 7° B. By this process the juice is rendered very weak and apt to ferment, and requires much fuel to concentrate it. Perhaps the best method is to expel the juice by centrifugal force. Another method practised near Heidelberg is, as soon as the beets are gathered and washed, to cut them into small rectangular pieces and dry them upon floors. Their bulk is thus reduced about 84 per cent., leaving 16 of dry matter, which may be kept for any time and transported to any distance. The sugar is then extracted by infusion or by maceration through a long series of vessels. The factory where this operation is carried on at Waghäusel is of immense extent, the buildings, formerly a Benedictine monastery, covering 12 acres of land. The infusing vessels, 20 in number, are 12 to 14 ft. deep and 7 ft. wide. The beets when dried produce about 46 per cent. of sugar. The juice, however obtained, is rendered alkaline by the addition of lime water, and is then boiled. Excess of lime is removed by the chemical process of converting it into carbonate by passing a current of carbonic acid gas into it, which may be generated by a coke furnace according to the method proposed by Barruel of Paris in 1811, or the gas may be generated by the action of sulphuric acid on chalk, as since proposed by Michaelis. This process is called de-liming, and it may also be effected by filtering the solution through animal charcoal. Several other methods have been employed or proposed. Dubrunfaut and Massey patented a method with caustic baryta, which forms with cane sugar at the boiling point an insoluble saccharate, $C_{12}H_{22}O_{11},BaO$, sufficient baryta being used to throw down all the sugar. The supernatant fluid, which contains all the impurities, is then run off, when the sugar is recovered by treating with carbonic acid, by which the baryta is withdrawn in the form of insoluble carbonate, the sugar dissolving. The subsequent processes of filtration, concentration, and granulation are similar to those already described. The manufacture of beet sugar has been attempted in the United States, but as yet with little success except in California, where it promises to become an important industry. (See CALIFORNIA, vol. iii., p. 605.)—*Maple Sugar.* Several species of the maple afford, when the sap begins to flow in the spring, a juice containing crystallizable sugar. That yielding the richest juice is the *acer saccharinum*, the rock or sugar maple. The swamp or river maple, known also as the white or soft maple, produces a juice of inferior quality, but which is sometimes employed in sugar making. The manufacture is said to have originated in New England about the year 1752. It thence extended throughout the wooded portions of the country where the sugar maple abounds, particularly New York, Michigan, Pennsylvania, and Ohio, and on the range of the Alleghanies further south. It is carried on in Canada both by whites and Indians. (See MAPLE.)—*Production and Trade.* Louisiana produces the great bulk of the cane sugar crop of the United States, and is the only state which exports sugar, the other cane-growing states producing scarcely sufficient for local consumption. The product of Louisiana from 1860 to 1873 is given under LOUISIANA. The crop of 1874 is estimated at 125,000 hhds., and of 1875 at 135,000 hhds. The total exports of sugar from Havana and Matanzas from Jan. 1 to Nov. 23, 1875, were 1,018,296 boxes, 249,331 hhds., or 332,105 tons, of which 344,187 boxes, 204,061 hhds., or 184,455 tons went to the United States. The imports of sugar from all sources, from Jan. 1 to Dec. 1, 1875, were: at New York, 408,981 tons; Boston, 111,192 tons; Philadelphia, 34,630 tons; Baltimore, 63,141 tons; total for the Atlantic coast, 617,944 tons, against 611,124 tons in 1874, and 598,995 tons in 1873, or an average of 609,354 tons for three years. The imports at San Francisco from Jan. 1 to Oct. 1, 1875, were: from Manila, 10,503 tons; Hawaiian islands, 6,679 tons; China, 2,038 tons; Central America, 324 tons; total, 19,544 tons, against 27,438 tons in 1874, and 21,132 tons in 1873, or an average of 22,705 tons for three years. The consumption of cane sugar on the Atlantic coast in 1874 was 710,369 tons; on the Pacific coast, 30,046 tons; of sugar made from molasses, 43,600 tons; of maple sugar, 15,000 tons; total, 799,015 tons, against 738,525 tons in 1873, and 720,873 tons in 1872, an increase in 1874 of 8 per cent. over 1873, and 11 per cent. over 1872. In nine months ending Sept. 30, 1875, the Atlantic ports exported of refined sugar 13,688 tons, against 3,030 tons in 1874, and 3,412 tons in 1873. The imports at the principal European depots in 1873, 1874, and for nine months

ending Sept. 30, 1875, are shown in the following table:

| DEPOTS. | | IMPORTS. | | |
|---|---|---|---|---|
| | | 1873. | 1874. | 1875. |
| Holland | tons. | 77,400 | 82,850 | 46,750 |
| Antwerp | " | 6,130 | 8,540 | 9,580 |
| Hamburg | " | 84,700 | 85,000 | 17,000 |
| France | " | 157,033 | 136,542 | 180,000 |
| Bremen | " | 980 | 1,890 | 8,840 |
| Trieste | " | 7,950 | 9,730 | 9,330 |
| Genoa | " | 18,900 | 21,000 | 17,500 |
| On the continent | " | 303,093 | 295,552 | 284,000 |
| In Great Britain | " | 653,588 | 676,488 | 760,652 |
| Total | " | 956,681 | 972,040 | 1,044,652 |

The imports from all sources into Great Britain were: in 1872, 784,000 tons; 1873, 833,500 tons; 1874, 835,000 tons. The consumption in the same years was 715,000, 786,000, and 836,000 tons. The importations of foreign refined, mainly beet sugar from France, were: in 1872, 87,700 tons; 1873, 118,000 tons; 1874, 136,000 tons. The production of beet sugar holds the balance of power in the sugar markets of the world. In the ten crop years from 1864–'5 to 1874–'5 the production increased from 545,000 to 1,054,000 tons. The principal producing countries are France, about 450,000 tons, and Germany, about 280,000 tons; the remainder is produced in Austria, Russia, and Holland.—Among the treatises on cane culture and the manufacture of sugar are: Champomier, "Statement of the Sugar Crop made in Louisiana" (annual reports, New Orleans, 1845–'57); Evans, "Sugar Planter's Manual" (London, 1847; Philadelphia, 1848); Wray, "Practical Sugar Planter" (London, 1848; latest ed., 1871); Leon, "Sugar Cultivation in Louisiana, Cuba, and the British Possessions" (London, 1848); Kerr, "Practical Treatise on the Cultivation of the Sugar Cane, and the Manufacture of Sugar" (London, 1851); Burgh, "Manufacture of Sugar and the Machinery Employed" (London, 1866); Reed, "History of Sugar and Yielding Plants" (London, 1866); and Soames, "Treatise on the Manufacture of Sugar" (London, 1872). The manufacture of beet sugar is described by Dumas in his *Traité de chimie appliquée aux arts*, vol. vi.; see also Dureau, *De la fabrication du sucre de betterave* (Paris, 1858); Grant, "Beet-Root Sugar and Cultivation of Beet" (Boston, 1867); and Crooks, "Manufacture of Beet-Root Sugar" (London, 1870).

**SUGAR OF LEAD.** See LEAD, vol. x., p. 246.

**SUGAR OF MILK.** See MILK, SUGAR OF.

**SUICIDE.** See FELO DE SE.

**SUIDAS**, a Greek lexicographer, supposed to have lived shortly after the 10th century A. D. His "Lexicon" contains articles on geography, biography, and history, under proper names, which are given coördinately with the words of the Greek language, and contains many extracts from ancient Greek writers, the works of some of whom are lost. It appears to have received additions from various hands. The first edition was published by Demetrius Chalcondyles (fol., Milan, 1499); the best are those of T. Gaisford (3 vols. fol., Oxford, 1834) and Bernhardy (4 vols., Halle, 1834–'53).

**SULIOTES**, a people of mixed Albanian and Greek descent, who formerly dwelt in the southern part of the pashalik of Janina, the ancient Epirus. They derive their origin from a number of families who in the 17th century fled from the tyranny of the Turks and took possession of the ridge of the Suli mountains and the valleys on both sides of it. In the second half of the 18th century the population numbered about 10,000, half Parasuliotes (subjugated people of different origin), and dwelt in 70 villages, Kako-Suli, 1,200 ft. above the river Acheron, being the chief. Near this village they erected the castle of Suli on a semilunar mountain, which terminates in so narrow a ridge as hardly to leave a path from one fortification to another. The Suliotes belonged to the Greek church, and their language was Albanian, although they also spoke Greek; their form of government was a mixture of oligarchy and democracy. They were divided into about 30 tribes or clans. In war they usually fought as skirmishers, each clan having its captain, subject to an officer called polemarch, who was elected by vote. In the war of 1787–'92 between Russia and Turkey, the Suliotes strongly supported the former power, defeated in 1789 the troops of Ali Pasha of Janina, ravaged Acarnania to the Achelous in 1790, and afterward invaded Arta and Janina, and aided the corsair Lambro Canzani with men and money. Deserted by the Russians after the peace of 1792, they fought desperately and successfully against the troops of Ali Pasha, who sought to exterminate them, and secured a truce for a few years. But in May, 1801, Ali renewed the war and put large numbers to the sword; the women threw themselves into the river rather than be captured. Most of the survivors, about 4,000, in 1803 retired to Parga. Compelled by Ali to leave this place, they went to the Ionian islands. Many afterward enlisted in the Greek regiments raised by the English during the war, which were disbanded in 1814. When in 1820 Ali Pasha, in revolt against the Porte, was hard pressed by the Turks under Kurshid Pasha, and deserted by the Albanians, he recalled the Suliotes. The tyrant of Janina fell in 1822, but the Suliotes remained hostile to the Porte, adhering to the cause of Grecian liberty. In spite of the heroic efforts of their leader, Marco Bozzaris, the Suliotes were hemmed in in their inaccessible valley; and at last, Suli being taken, Sept. 4, 1822, they accepted the offer of an asylum from the governor of the Ionian islands. About 2,000 were carried in English ships to Cephalonia, the remainder dispersing among the mountains.

**SULLA**, or **Sylla, Lucius Cornelius (Felix)**, a Roman dictator, born in 138 B. C., died in 78.

The family was originally called Rufinus and belonged to the great Cornelia *gens*. He acquainted himself with Greek and Roman literature, and was said to have all the accomplishments and all the vices of the day. Inheriting the property of his stepmother and of a courtesan, he aspired to the honors of state. In 107 B. C. he was elected quæstor, and was sent with cavalry to Africa to aid Marius in the Jugurthine war. Marius regarded him as a profligate patrician ignorant of war, but Sulla's conduct soon won his esteem and the affection of his soldiers. He took a leading part in the battle of Cirta and in the transactions which ended in the betrayal of Jugurtha. In 104 he was legate under Marius during the threatening invasion of the Cimbri and Teutons; in 103 he was military tribune; in 102 he left Marius, who had become jealous of him, to serve under Q. Catulus, who made him chief manager of affairs; and in 101 he was engaged in the great battle which completely destroyed the Cimbri. In 93, by a liberal distribution of money among the people, he gained the prætorship. In 92 he was sent as proprætor to Cilicia to restore Ariobarzanes to his kingdom of Cappadocia, from which Mithridates had expelled him. His success attracted the attention of Arsaces, king of Parthia, who sent an embassy to Sulla to solicit an alliance with the Romans. On his return to Rome both he and Marius, representatives of the aristocratic and popular parties respectively, desired the command of the army in the impending war against Mithridates; but the breaking out of the social war checked their private feuds and united the two generals against the common foe. In this war Sulla's successes far outshone those of Marius; but his most brilliant exploits were in 89, when as legate of the consul L. Cato he destroyed Stabiæ, subjugated the Hirpini, defeated the Samnites, and captured their chief town, Bovianum. In 88 he became consul, and was appointed to the command against Mithridates. Marius conspired with the tribune P. Sulpicius Rufus and with the lately enfranchised Italians to wrest this command from Sulla, and succeeded in driving him out of the city. He hastened to the army then besieging Nola, persuaded six legions to march under him against Rome, entered the city, and drove out Marius. Early in 87 he joined his troops at Capua, embarked for Greece, and began the war against Mithridates. In 86, after a long siege, he took and plundered Athens, and from this time till his return to Rome in the spring of 83 he enjoyed almost uninterrupted success. In the mean time Marius and L. Cinna returned to Rome and were elected consuls. Sulla was declared a public enemy, and against both him and Mithridates was sent an army, which in 85, under Fimbria, gained several victories over the armies of Mithridates in Asia, while Sulla in the same year defeated his army in Greece. In 84 Sulla made peace with Mithridates, and turning his attention to Fimbria, then at Thyatira, he defeated him. Fimbria, deserted by his soldiers, committed suicide. Sulla exacted enormous sums from Asiatic cities, and then set sail with his army for Athens, from which he carried to Rome the celebrated library of Apellicon. Although both Marius and Cinna were dead, the Marian party were still strong against Sulla; but by victories, by intrigues, and by seducing their soldiers to join his own army, Sulla succeeded in shutting up the younger Marius in Præneste, and leaving a force to besiege the place, he hastened with the bulk of his army to Rome, which was threatened by the Samnites and Lucanians. Both armies arrived almost simultaneously, and before the Colline gate was fought, Nov. 1, 82, the great battle in which 50,000 men on each side are said to have fallen. The victorious Sulla massacred all his Samnite prisoners. Præneste soon surrendered; the Prænestines and Samnites were slaughtered, and the younger Marius killed himself. This ended the Marian war. The next step of Sulla, now master of Rome, was to extirpate the popular party. At the close of 82 the dictatorship, which had been in abeyance for about 130 years, was revived, and Sulla as dictator had absolute power over the lives and property of all citizens. A reign of terror followed. Sulla posted in the forum a list called a *proscriptio* of persons to be considered as outlaws, who might be killed by any one, and their confiscated property was to be sold at auction. Fresh lists constantly appeared, till Sulla was rid of his enemies, while their property helped to enrich his friends. But he did not intend to abolish the republic, and in 80 he was elected consul, still holding the dictatorship. In 80–79 he introduced his reforms in the constitution and established military colonies throughout Italy. All his reforms were by *leges*, including the laws relating to the constitution, to the religious corporations, to the administration of justice, and to the improvement of public morals. Having effected these reforms, he voluntarily resigned the dictatorship in 79, and retired to his estate at Puteoli, where he devoted himself to literary and sensual enjoyments. His excesses shortened his life; the immediate cause of his death was the rupture of a blood vessel. He had just completed the 22d book of his memoirs, which have not come down to us, but were largely used by Plutarch. The senate gave him a public funeral, which was a gorgeous pageant. His monument in the Campus Martius bore an inscription, said to have been composed by himself, to the effect that none of his friends ever did him a kindness, and none of his enemies a wrong, without being fully repaid. His constitutional reforms endured but a few years, and only paved the way for the advent of the Cæsars.

**SULLIVAN**, the name of six counties in the United States. **I.** A W. county of New Hamp-

shire, drained by small tributaries of the Connecticut river; area, about 820 sq. m.; pop. in 1870, 18,058. The valley of the Connecticut is level and contains much excellent land; the rest of the county is broken and sometimes hilly. It is traversed by several railroads. The chief productions in 1870 were 16,864 bushels of wheat, 138,071 of Indian corn, 124,819 of oats, 13,945 of barley, 286,721 of potatoes, 206,629 lbs. of wool, 576,725 of butter, 100,429 of cheese, 342,398 of maple sugar, and 54,583 tons of hay. There were 3,615 horses, 6,832 milch cows, 3,122 working oxen, 8,631 other cattle, 39,078 sheep, and 2,829 swine; 9 manufactories of woollen goods, 5 of wooden ware, 3 of paper, 5 of machinery, 2 of cotton goods, 2 of boots and shoes, 5 flour mills, 6 tanneries, 4 currying establishments, and 24 saw mills. Capital, Newport. **II.** A S. county of New York, separated from Pennsylvania by the Delaware river, and watered by several streams; area, about 880 sq. m.; pop. in 1875, 34,935. The surface is elevated and intersected N. E. and S. W. by several ridges. The valleys are generally wide and fertile. It is traversed by the Delaware and Hudson canal and several railroads. The chief productions in 1870 were 5,136 bushels of wheat, 49,025 of rye, 181,551 of Indian corn, 231,954 of oats, 130,421 of buckwheat, 236,881 of potatoes, 22,011 lbs. of wool, 1,183,642 of butter, and 65,992 tons of hay. There were 4,168 horses, 13,987 milch cows, 4,369 working oxen, 12,568 other cattle, 12,352 sheep, and 5,471 swine; 18 manufactories of carriages and wagons, 15 flour mills, 34 tanneries, 8 currying establishments, and 45 saw mills. Capital, Monticello. **III.** A N. E. county of Pennsylvania, drained by tributaries of the Susquehanna river; area, about 450 sq. m.; pop. in 1870, 6,191. The surface is generally rolling and hilly. The chief productions in 1870 were 16,360 bushels of wheat, 5,678 of rye, 42,942 of Indian corn, 76,141 of oats, 34,453 of buckwheat, 52,507 of potatoes, 21,219 lbs. of wool, 20,700 of maple sugar, 229,972 of butter, and 13,446 tons of hay. There were 1,074 horses, 2,705 milch cows, 3,990 other cattle, 6,976 sheep, and 1,982 swine; 1 flour mill, 5 tanneries, 2 currying establishments, and 6 saw mills. Capital, Laporte. **IV.** A N. E. county of Tennessee, bordering on Virginia and intersected by the Holston river; area, 300 sq. m.; pop. in 1870, 13,136, of whom 857 were colored. The surface is very hilly and well timbered, and the soil fertile. Iron ore and coal are found. The East Tennessee, Virginia, and Georgia railroad passes through it. The chief productions in 1870 were 132,647 bushels of wheat, 302,227 of Indian corn, 176,387 of oats, 16,307 lbs. of tobacco, 27,026 of wool, 171,872 of butter, 7,785 of flax, 12,360 of maple sugar, 18,120 of honey, and 20,077 gallons of sorghum molasses. There were 3,384 horses, 3,405 milch cows, 5,535 other cattle, 15,634 sheep, and 18,478 swine; 13 flour mills, and 3 saw mills. Capital, Blountsville. **V.** A S. W. county of Indiana, separated from Illinois by the Wabash river; area, 430 sq. m.; pop. in 1870, 18,453. The surface is generally level and the soil fertile. The chief productions in 1870 were 297,452 bushels of wheat, 766,801 of Indian corn, 93,736 of oats, 43,692 of potatoes, 9,805 tons of hay, 4,125 lbs. of tobacco, 67,640 of wool, 176,279 of butter, 42,250 of maple sugar, and 39,166 gallons of sorghum molasses. There were 6,912 horses, 4,892 milch cows, 7,027 other cattle, 27,246 sheep, and 32,030 swine; 4 cooperages, 8 flour mills, and 19 saw mills. The Evansville and Crawfordsville railroad passes through the capital, Sullivan. **VI.** A N. county of Missouri, drained by tributaries of Grand river; area, 648 sq. m.; pop. in 1870, 11,907, of whom 42 were colored. The surface is rolling, about two thirds being prairie and one third timbered. The soil is productive; coal is found. The chief productions in 1870 were 61,467 bushels of wheat, 15,826 of rye, 412,624 of Indian corn, 164,614 of oats, 38,754 of potatoes, 26,619 lbs. of tobacco, 70,094 of wool, 234,065 of butter, and 14,569 tons of hay. There were 6,171 horses, 665 mules and asses, 5,024 milch cows, 9,926 other cattle, 25,369 sheep, and 17,770 swine; 11 flour mills, 5 saw mills, and 3 wool-carding and cloth-dressing establishments. Capital, Milan.

**SULLIVAN, Arthur S.**, an English composer, born in London in 1844. He was instructed by his father, a music teacher, and sang for three years when a boy at the chapel royal. At the age of 14 he gained the Mendelssohn scholarship, and continued his studies at the royal academy under John Goss and Sir Sterndale Bennett. He then studied under Rietz, Hauptmann, and Moscheles, in Leipsic, and composed the incidental music to Shakespeare's "Tempest," performed for the first time at the crystal palace in 1862. He soon after composed an opera, never played, with the libretto by Chorley, entitled "The Sapphire Necklace." He has written three cantatas, "Kenilworth," "On Sea and Land," and "The Bride of Neath Valley;" a symphony performed at Liverpool in 1866; several overtures; three operettas, "Thespis," "Contrabandista," and "Box and Cox;" and two oratorios, "The Prodigal Son," produced at the Worcester festival in 1868, and "The Light of the World," produced at the Birmingham festival in 1873. He has also composed songs and piano music, including "The Songs of the Wrens," for which the words were written by Alfred Tennyson.

**SULLIVAN, Barry.** See p. 900.

**SULLIVAN. I. John**, an American general, born in Berwick, Me., Feb. 17, 1740, died in Durham, N. H., Jan. 23, 1795. He practised law in Durham. In 1774 he was a member of the first general congress, and in December of that year, with John Langdon, led a force against Fort William and Mary, near Portsmouth, and seized 100 barrels of gunpowder, 15 cannon, all the small arms, and other stores.

This was the first act of armed hostility committed in the colonies. In June, 1775, he was appointed by congress a brigadier general, and commanded on Winter hill at the siege of Boston. After its evacuation he was sent to reenforce the army in Canada, where, after the death of Gen. Thomas, he took command, June 2, 1776, and conducted the retreat from the province. He was commissioned by congress as major general, Aug. 10, acted under Putnam on Long Island, and by a combat of two hours in the woods (Aug. 27) contributed to the preservation of the American army. He was taken prisoner, but was exchanged for Gen. Prescott. After Gen. Lee's capture Sullivan took command of his division, and led the right at Trenton on Christmas night, 1776. On Aug. 22, 1777, he made a bold descent on Staten Island, the entire success of which was prevented by misconstruction of his orders, but he was justified by a court of inquiry and by a vote of congress. He commanded the right wing at the battle of Brandywine. He defeated the British left at Germantown, but mistakes on the American left, occasioned by fog, changed a victory into a repulse. In August, 1778, he commanded in Rhode Island, and prepared to attack the British lines at Newport, but was deprived of the coöperation of the French fleet under D'Estaing, and was obliged to raise the siege; but at Butt's hill, on the 29th, he repulsed the enemy, and withdrew from the island with slight loss. On Aug. 29, 1779, he defeated the Indians under Brant and tories under Sir John Johnson, at Newtown, near the present site of Elmira, N. Y. He then resigned his commission on account of ill health. In the autumn of 1780 he again took his seat as a member of congress. In 1782-'6 he was attorney general of New Hampshire, and in 1786-'9 president of the state. In the troubles of 1786 he saved the state from anarchy by his intrepidity and good management, and in 1788 secured the ratification of the federal constitution. In 1789 he was appointed federal judge of New Hampshire, which office he held till his death. His life has been written by O. W. B. Peabody, in Sparks's "American Biography," 2d series, vol. iii., and by Thomas C. Amory (1868).—His son George (1774-1838) was an eminent lawyer, and was several times a member of the legislature, of congress 1811-'13, and attorney general of the state 1805-'7 and 1816-'35. **II. James**, governor of Massachusetts, brother of the preceding, born in Berwick, Me., April 22, 1744, died in Boston, Dec. 10, 1808. He was king's attorney for York co., Me., but joined the revolutionary movement. He was a member of the provincial congress of Massachusetts (of which Maine then formed a part) in 1775, and with two others executed a difficult commission to Ticonderoga. In 1776 he was appointed a judge of the superior court, and in 1779-'80 was a member of the convention which framed the constitution of the state. In 1783 he was chosen a member of congress; and he was repeatedly elected a representative of Boston (to which place he had removed) in the legislature. In 1787 he was a member of the executive council and judge of probate for Suffolk co., from 1790 to 1807 was attorney general of the state, and was elected governor in 1807 and 1808. He was one of the commissioners for settling the boundaries between the United States and the British provinces. He published a "History of the District of Maine" (1795), and "History of Land Titles in Massachusetts" (1801). **III. William**, son of the preceding, born in Saco, Me., Nov. 30, 1774, died in Boston, Sept. 3, 1839. He graduated at Harvard college in 1792, studied law, and was long president of the association of the Suffolk bar. He was constantly a member of one or the other branch of the state legislature. He published "Familiar Letters on Public Characters and Events from 1783 to 1815" (12mo, Boston, 1834); "Historical Causes and Effects, from the Fall of the Roman Empire to the Reformation in 1517" (8vo, 1838); and "The Public Men of the Revolution," published with a biographical sketch by his son, J. T. S. Sullivan (8vo, Philadelphia, 1847). **IV. John Langdon**, an American engineer, brother of the preceding, born in Saco, Me., April 9, 1777, died in Boston, Mass., Feb. 9, 1865. He travelled in Europe, studying the construction of canals in France and England, and in 1804 was appointed agent and engineer of the Middlesex canal, which was completed in seven years. He invented the steam towboat, for which he received a patent in 1814, in preference to Robert Fulton, who applied for it at the same time, his priority of discovery being fully sustained. In 1824 he was appointed associate civil engineer of the United States board of internal improvements, which post he resigned the next year, after making a report on the practicability of a canal across the Alleghanies. He then studied medicine, in 1837 commenced practice in New Haven, afterward adopted the homœopathic system, and in 1847 removed to New York.

**SULLIVAN'S ISLAND.** See Moultrie, Fort.

**SULLIVANT, William Starling**, an American botanist, born at Franklinton, near the site of Columbus O., Jan. 15, 1803, died in Columbus, April 30, 1873. He graduated at Yale college in 1823, and settled in Columbus as a surveyor. In 1840 he published a "Catalogue of Plants, Native or Naturalized in the Vicinity of Columbus, Ohio," and in 1842 an article on three new plants discovered in that district. He made a journey in 1843 from Maryland to Georgia, and published "Musci Alleghanienses" (55 sets, of 2 vols. 4to each, 1845; new ed., printed privately, 1855). He wrote papers on bryology and hepaticology for the "Memoirs of the American Academy of Arts and Sciences" (1846-'9), and contributed the "Musci and Hepaticæ of the United States East of the Mississippi River" to the second edition of

Gray's "Manual of Botany" (1856); this was afterward published separately. A second volume of this, his most important work, has appeared since his death. *Musci Boreali-Americani*, consisting of 350 species and varieties of dried mosses, was the joint work of himself and his associate L. Lesquereux (1856). He also published "Mosses brought home by Wilkes's Exploring Expedition, 1838–'42" (with 26 fol. plates, 1859); "Mosses and Hepaticæ collected mostly in Japan" (with 18 4to plates, 1860); *Musci Cubenses* (1861); and *Icones Muscorum* (with 129 plates, 1864). The genus *Sullivantia* was founded by Torrey and Gray upon a rare plant of the saxifrage family discovered by him.

**SULLY**, a S. central county of Dakota, recently formed and not included in the census of 1870; area, about 1,300 sq. m. It is bounded W. by the Missouri and watered by its affluents. The surface is mostly undulating prairies. The Missouri bottom is very productive.

**SULLY, Maximilien de Béthune**, baron de Rosny, duke of, a French statesman, born at Rosny, near Mantes, Dec. 13, 1560, died near Chartres, Dec. 22, 1641. He belonged to a noble Protestant family, and followed King Henry of Navarre in all his wars, and became his chief adviser. When his master, on the death of Henry III., claimed the throne of France, Rosny advised him to turn Catholic in order to reconcile the majority of the nation to his cause. On a secret mission to Queen Elizabeth of England, he secured her assistance to Henry IV., and he was instrumental as an engineer in taking Dreux in 1593, Laon in 1594, La Fère in 1596, and Amiens in 1597. In 1597 he was appointed superintendent of finance, and became in fact the chief minister of Henry IV. He reformed the financial system, and cancelled the public debt, which amounted to 332,000,000 livres, remitting 20,000,000 taxes in arrears, alleviating the annual taxation, and gathering a reserve of 17,000,000, which was deposited in the Bastile. He fostered agriculture, made the grain trade free, suppressed tolls and prohibitions, built or improved highways and roads, constructed canals, and encouraged drainage and mining. He had received the title of marquis of Rosny in 1601, and was created duke of Sully in 1606. At the death of Henry IV. in 1610 the reserve in the Bastile amounted to 42,000,000. Sully remained as chief minister some time longer, but his severity and rigid principles becoming obnoxious to Maria de' Medici and her advisers, he left the court in 1611, and resigned most of his offices and dignities. Cardinal Richelieu in 1634 made him marshal of France. During his retirement he composed his personal memoirs, *Mémoires des sages et royales économies d'État de Henry le Grand* (4 vols. fol., 1634–'62, several times reprinted; English translation by Mrs. Lennox, 3 vols. 4to, London, 1756; new ed., 5 vols. 8vo, 1854–'6).—See *Éloge historique de Sully*, by Perrens (Paris, 1871).

**SULLY, Thomas**, an American painter, born at Horncastle, Lincolnshire, England, in June, 1783, died in Philadelphia, Nov. 5, 1872. He was brought to the United States by his parents, who were players, in 1792. In 1803 he settled as a portrait painter in Richmond, Va., removed a few years later to New York, and in 1809 settled in Philadelphia. Among his large works are full-length portraits of George Frederick Cooke as Richard the Third, Dr. Benjamin Rush, Commodore Decatur, Thomas Jefferson, Lafayette, and Queen Victoria, painted during a visit to England. His well known picture of "Washington crossing the Delaware" is now in the Boston museum.

**SULPHATES**, salts formed by the union of sulphuric acid with bases. The union, strictly speaking, is only partial, as a portion, and in normal salts all, of the hydrogen of the sulphuric acid is displaced by the basyle. (See SALTS.) Thus, $H_2SO_4 + 2K = 2H + K_2SO_4$, normal sulphate of potassium; or $H_2SO_4 + K = H + KHSO_4$, acid sulphate of potassium. The sulphates are extensively employed in the arts, in medicine, in agriculture, and in the chemical laboratory. 1. *Sulphates of Alumina.* The normal sulphate, $Al_2 3SO_3 + 18H_2O$, is found native in many localities, as on the volcanic island of Milo in the Grecian archipelago, in the craters of volcanoes in the Andes, and at Adelaide in Australia. It is known in mineralogy as alunogen, hair salt, feather alum, and halotrichite. Its hardness is 1·5 to 2; sp. gr. 1·6 to 1·8; lustre vitreous; color white, or tinged with yellow or red. It is manufactured in large quantities, is known in commerce as concentrated alum, and is used in dyeing instead of common alum. Clay as free as possible from iron is heated to redness, and then ground and mixed with half its weight of sulphuric acid of sp. gr. 1·45, in a reverberatory furnace, till the acid begins to volatilize. After exposure to the air for several days, water is added and the solution freed from what iron it may contain by precipitation with ferrocyanide of potassium. The solution is then evaporated to a sirup, which solidifies on cooling. It is soluble in two parts of water, insoluble in alcohol. There is a series of double aluminic sulphates, forming true alums, which are treated under the head of ALUM. Not all alums contain aluminum, but they are so named because they are formed on the type of the alum salts. 2. *Sulphates of Barium.* Some of the sulphates of barium are double salts. The most important is the neutral sulphate, $BaSO_4$, or heavy spar, which is found native in large quantities, and when ground into powder is used to adulterate white lead as a pigment. An amorphous sulphate is made on a large scale for the same purpose, and called permanent white. There is an acid salt, $BaH_2 2SO_4$, and a basic soda sulphate, $BaN_2 2SO_4$. 3. *Sulphates of Calcium and Chromium.* An anhydrous neutral sulphate of calcium, $CaSO_4$, occurs native as the mineral an-

hydrite. It may be formed artificially in crystals by fusing sulphate of potash with an excess of chloride of calcium. Gypsum is native hydrated sulphate of calcium, $CaSO_4 2H_2O$. (See GYPSUM.) The sulphates of chromium, both the pure chromium and also the double salts, are an important class of compounds, and include the chrome alums, as ammonio-chrome alum, potassio-chrome alum, and sodio-chrome alum. 4. *Sulphates of Copper.* The normal sulphate, $CuSO_4 + 5H_2O$, is the blue vitriol of commerce, extensively used in the arts. (See COPPER, vol. v., pp. 318–'19.) There are several basic sulphates of copper, and double sulphates of copper and ammonia of various shades of blue, some of which form solutions of exceeding beauty. By mixing solutions of ammonio-cupric sulphates or of potassio-cupric sulphates with corresponding double sulphates of cobalt, iron, magnesium, manganese, nickel, or zinc, an interesting series of complex salts is obtained, all of which crystallize in monoclinic prisms and tables, isomorphous with the magnesium double salts; and furthermore, by mixing the solutions of three or four of these double salts, others still more complex may be formed, isomorphous with the preceding. Copper also forms with magnesium, sodium, and zinc beautiful double sulphates. In the preparation of cupric sulphate from materials which contain iron compounds, several so-called ferroso-cupric sulphates are formed, having different proportions of base, but which are not true double salts. The Salzburg vitriol, prepared at Buxweiler in Alsace, contains 3 molecules of iron to 1 of copper; Admont vitriol, 5 to 1; Baireuth vitriol, 7 to 1. 5. *Sulphates of Iron.* Sulphuric acid forms with iron an extensive series of salts, some of which have a constitution analogous to the peroxide, and are called ferric salts; others, analogous to the protoxide, are called ferrous salts. Among the former are several interesting double salts, including ammonio-ferric sulphate, or ammonia-iron alum, and potassio-ferric sulphate, or potash-iron alum. Ferrous sulphate, green vitriol, or copperas, $FeSO_4 + 7H_2O$ (or $FeOSO_3 + 7HO$, old formula), is the most important commercial salt of iron. It occurs native, sometimes in crystals, but more often in amorphous masses, in iron mines in various parts of the world, being formed by the oxidation of iron pyrites; but most of the copperas consumed in the arts is prepared simultaneously with alum from schists containing iron pyrites. Ferrous sulphate crystallizes in monoclinic prisms or tables, which when moist readily absorb oxygen and pass into ferric sulphate; but if crushed and deprived of moisture by strong pressure between folds of cotton cloth or filter paper, it may be kept in bottles for a long time without change. (See COPPERAS.) 6. *Other Metallic Sulphates.* The normal sulphate of magnesium, $MgSO_4 + 7H_2O$, is described under the title EPSOM SALT. There is an acid sulphate and several double salts. The sulphates of potassium are described with that metal. Glauber's salt is the normal and principal sulphate of sodium. (See GLAUBER'S SALT.) The other metallic sulphates of sufficient importance are treated under the heads of the respective metals. 7. *Alcoholic Sulphates.* Sulphuric acid combines with various alcohol radicals to form a series of sulphuric ethers, the most important among which are acid sulphate of ethyle, or sulphovinic acid, $(C_2H_5)HSO_4$, and neutral sulphate of ethyle, or true sulphuric ether, $(C_2H_5)_2SO_4$. (This latter ether must be distinguished from what is ordinarily called sulphuric ether, which is the oxide and not the sulphate of the radical ethyle, $C_2H_5$.) Sulphovinic acid is formed by the action of strong sulphuric acid upon alcohol, ether, or ethylene, and was first noticed by Dabil in 1800 in the residues of the preparation of common ether. The molecule of hydrogen which it contains may be replaced by a metal forming a salt which is called a sulphovinate, or ethyle sulphate. Neutral sulphate of ethyle, or true sulphuric ether, is formed by passing sulphuric anhydride into a flask containing common sulphuric ether surrounded by a freezing mixture. It is a yellowish oily liquid of sp. gr. 1·12, having a sharp taste and the odor of oil of peppermint. As it is decomposed when heated in the air, it must be distilled in an atmosphere of carbonic anhydride. Sulphuric acid forms with methyle an acid sulphate of methyle, or sulpho-methylic acid, $CH_3HSO_4$, and a neutral sulphate of methyle or methylsulphuric ether, $(CH_3)_3SO_4$. The molecule of hydrogen in sulpho-methylic acid may be replaced by a metal, forming a salt called a methyl-sulphate.

**SULPHIDES,** or **Sulphurets,** compounds in which sulphur forms the electro-negative element. Sulphur unites with all the metals, with most of the non-metallic elements, and with many organic radicals. The sulphides have generally a constitution corresponding to the oxides, and like them may be divided into acid and basic sulphides, which are capable of uniting and forming sulphur salts. Thus, we have stannate of potassium, $K_2SnO_3$, and also sulphostannate of potassium, $K_2SnS_3$. The sulphides are decomposed more or less perfectly by hydrochloric acid, and behave like the corresponding oxides, yielding one molecule of sulphydric acid for every molecule of sulphur in the sulphide. Thus, $FeS + 2HCl = H_2S + FeCl_2$; and $SbS_3 + 6HCl = 3H_2S + 2SbCl_3$. Of the sulphides of the non-metallic elements, those of carbon and chlorine are the most important. Bisulphide of carbon, carbon disulphide, or sulpho-carbonic acid, $CS_2$, is the only sulphide of carbon which is positively known. It is prepared on a large scale as a solvent for various manufacturing purposes. A large earthen retort has a tube which passes through the mouth down to near the bottom. The retort is filled with charcoal and heated to redness in a furnace, and bits of sulphur are dropped from

time to time down the tube, which after each introduction is stopped with a cork. The neck of the retort is connected with a condensing tube, which is kept cold by a stream of water, and dips into a vessel of cold water. The sulphide which collects at the bottom of this vessel contains an excess of sulphur, from which it is freed by redistillation. By another process sulphur vapor is driven over red-hot coke. Sulphide of carbon is a colorless, mobile, highly refracting liquid, its index of refraction being 1·678. (See LIGHT, vol. x., p. 439.) It has a peculiar, fetid, disagreeable, alliaceous odor, and when breathed produces great depression, followed by coma. The density of the liquid is 1·274, water=1; of the vapor, 2·67, air=1; boiling point, 118·4°. It freely dissolves sulphur, depositing it on evaporation in beautiful octahedral crystals. It also dissolves phosphorus, iodine, camphor, and caoutchouc, and mixes easily with oils. It is extensively used in the vulcanization of caoutchouc and the manufacture of gutta percha, for extracting bitumen from mineral substances, and of oil from seeds. Sulphide of chlorine, $S_2Cl_2$, is formed by passing dry chlorine over melted sulphur contained in a glass retort. A deep orange-yellow, mobile fluid distils over, having a peculiar disagreeable odor, boiling at 282° F.; sp. gr. 1·687. It dissolves sulphur in large quantities. Dissolved in crude benzole with excess of sulphur, it is also used in Europe for vulcanizing caoutchouc. The principal sulphides of organic radicals are of the alcoholic series, and form a class of ethers, as hydrosulphuric ether, or monosulphide of ethyle, $(C_2H_5)_2S$, and the disulphide, $(C_2H_5)_2S_2$. Sulphydrate of ethyle, or *mercaptan*, $C_2H_5SH$, is interesting as being the sulphur analogue of common alcohol, or hydrated oxide of ethyle, $C_2H_5OH$. (See ALCOHOL, and ETHYLE.) Mercaptan (*mercurium captans*, which signifies having a strong tendency to seize upon or combine with mercury) was discovered by Leise in 1833, and has since been examined by Liebig and others. It is a colorless mobile liquid, of an exceedingly offensive and permanent garlic odor; sp. gr. 0·842; boiling point about 144° F. When it is mixed with mercuric oxide, violent reaction ensues, with formation of water, and a white substance, soluble in alcohol, which by the action of sulphydric acid yields sulphide of mercury with reproduction of mercaptan. A drop on the end of a glass rod waved through the air will evaporate so rapidly as to freeze a portion remaining. It forms an interesting class of compounds with other elements, for which the reader is referred to larger works on chemistry. The sulphides of methyle, $(CH_3)_2S$ and $(CH_3)_2S_2$, and also methyle sulphydrate, or methyle mercaptan, $CH_3SH$, and other organic sulphides and sulphydrates, possess much chemical interest.

**SULPHITES,** salts formed by the union of sulphurous acid with bases, or more strictly speaking by the action of sulphurous acid on bases; the two atoms of hydrogen in the molecule of the acid being partially or wholly replaced by a metallic basyle or a radical, forming normal and acid salts. (See SALTS.) Thus, normal sulphite of potassium, $K_2SO_3$, may be formed by wholly replacing the hydrogen in the acid, $H_2SO_3$; or the acid sulphite, $KHSO_3$, may be formed by employing half the quantity of acid. The sulphites of the metals are usually formed by passing sulphurous anhydride, $SO_2$, through aqueous solutions or mixtures of hydrates or carbonates, the anhydride being first converted into the acid by combining with the elements of water, whereupon double decomposition immediately takes place, with an exchange between the metallic basyle and the hydrogen constituent of the acid. Sulphurous acid combines with nearly all the metals, the most important sulphites being those of calcium and sodium. Sulphite of calcium may be precipitated in an anhydrous state by passing sulphurous anhydride through water having hydrate of lime in suspension, or through a solution of chloride of calcium. It is manufactured on a large scale and used in bleaching, and for protecting organic substances from decay. The sulphites of sodium comprise a normal salt, $Na_2SO_3$, and an acid salt, $NaHSO_3$. The normal salt is prepared by saturating a solution of carbonate of soda with sulphurous acid and adding to it as much carbonate of soda as it originally contained while warm. On cooling, the salt separates in monoclinic crystals, having seven molecules of water of crystallization ($Na_2SO_3+7H_2O$). Another hydrate was formed by Muspratt, containing ten molecules of water. The acid sulphite is prepared by supersaturating the solution of sodic carbonate with sulphurous acid. Both of these salts have been used to remove the traces of chlorine in paper pulp, under the name of antichlor, but they have been partially superseded by hyposulphite of sodium, or this salt is used in connection with them. (See PAPER.)—The two atoms of hydrogen in the molecule of sulphurous acid may be partly or wholly replaced by monatomic alcohol radicals, forming acid and neutral sulphurous ethers, the acid ethers being sometimes called sulpho-acids. Ethylsulphurous acid, $(C_2H_5)HSO_3$, is formed by the action of nitric acid on sulphydrate of ethyle or mercaptan, $(C_2H_5)HS$. Neutral sulphurous ether, $(C_2H_5)_2SO_3$, may be formed, among other methods, by the action of absolute alcohol on disulphide of chlorine. The alcoholic sulphites and other sulpho-ethers and compounds have been carefully studied by Muspratt, Gerhardt, Rammelsberg, Kolbe, and others. They form an extensive and interesting series.

**SULPHUR,** an elementary substance belonging to the class of metalloids. It has been known from the earliest times as the sublimed product of volcanoes, and as a natural mineral deposit in clay and marl strata in tertiary formations, and is also associated with gypsum, being one of the sources of this mineral. (See GYPSUM.)

It occurs in some schistose rocks, and in coal and lignite deposits, and is deposited from the sulphuretted waters of certain mineral springs. It is found in Sicily in beds of blue clay lying in a matrix of rock salt, gypsum, and celestine. (See STRONTIUM.) It also exists in primitive rocks, as granite and mica, and abounds in the lava fissures of volcanic craters, as in the *solfatara* near Naples and at Popocatepetl, Mexico. It is a constituent of many minerals, such as iron and copper pyrites, galena or sulphuret of lead, cinnabar or sulphuret of mercury, gray antimony, and realgar or sulphuret of arsenic; also of ternary salts of metals, such as the sulphates of copper and iron, and of strontia, barium, and calcium (celestine, heavy spar, and gypsum); and of more soluble compounds which are constituents of mineral waters, as the sulphates of magnesium and sodium (Epsom and Glauber's salts). It is a constituent of the proteine compounds of animals and vegetables, in the taurine of bile and the cystine of urine, and certain volatile oils, as oil of onions and oil of mustard.—Sulphur is obtained from the natural deposits of free sulphur by melting or by distillation. Rich deposits are simply melted in large cast-iron or earthen caldrons, the gangue and small stones being removed with perforated ladles. Sometimes rude furnaces somewhat like lime kilns are employed for the coarser deposits, in which a portion of the sulphur is burned, while the great mass is drawn off at the bottom. A better method than the latter is that of distillation, as the product is much purer. This is done in large earthen pots or retorts placed in a long furnace. Rude receivers of earthenware or wood are placed outside of the furnace in which the sublimate is condensed. The product obtained by melting is known as rough sulphur, and contains about 3 per cent. of foreign matter, from which it is separated by distillation, in stills having large chambers for condensers, in which it is deposited in the form known as flowers of sulphur; or it may be condensed in the liquid form in smaller and hotter receivers, and cast into cylinders called roll sulphur. Sulphur may also be obtained from iron pyrites by heating it in close vessels, in which case the dioxide parts with one molecule of sulphur and becomes protoxide. It is one of the products of the heating of copper pyrites preliminary to copper smelting. Sulphur is also a by-product of gas manufacture when salts of iron are used to decompose sulphuretted hydrogen. (See GAS, vol. vii., p. 637.) The iron salt, which before using is mixed with lime and exposed to the air to convert it into peroxide, in the gas-purifying process becomes a hydrated sulphide. This is again reconverted into peroxide by exposure to the air, with evolution of sulphur.—*Properties.* Native sulphur occurs either in amorphous masses, or in transparent yellow crystals derived from the octahedron with a rhombic base. Sublimed sulphur of commerce, known as flowers of sulphur, is a yellow gritty powder having a slight peculiar odor, but from its insolubility is nearly tasteless. It is a non-conductor of electricity, and becomes negatively excited on being rubbed by most substances. It has a strong affinity for oxygen, taking fire when heated in the air to 455°, burning with a blue flame and emitting suffocating fumes of sulphurous anhydride. It is therefore classed among highly inflammable substances. It melts at 239°, forming an amber-yellow liquid which is lighter than solid sulphur. It boils at about 836°, forming a deep yellow vapor of sp. gr. 6·617, one volume of which contains three atoms of sulphur. When heated to about 1832° the vapor is only one third as dense as at 900°, and then has the same atomic volume as oxygen. Sulphur has also a very strong affinity for chlorine, bromine, and iodine, forming respectively chlorides, bromides, and iodides of sulphur. It combines readily with most of the metals, forming sulphides or sulphurets, which generally have a constitution corresponding to the oxides of the same metals. Sulphur, like phosphorus, is remarkable for the number of modifications or allotropic conditions which it may assume under different circumstances. (See ALLOTROPISM, and PHOSPHORUS.) These different modifications are divided into two distinct varieties, those in the first variety being soluble and those in the second insoluble in bisulphide of carbon. Berthelot has named the first or soluble variety electro-positive sulphur, because it is separated at the positive electrode of a galvanic battery during the electrolysis of a solution of hydrosulphuric acid, and also because it is in this form that it is separated from sulphides of electro-positive metals. The second variety he named electro-negative sulphur, because it appears at the negative pole of the battery during the decomposition of sulphurous acid, and separates from sulphur compounds with electro-negative elements, as chlorine, bromine, iodine, and oxygen. Soluble sulphur, or that which is soluble in bisulphide of carbon, presents three forms, two crystalline and one amorphous. In the first the crystals are octahedrons with a rhombic base, and all the modifications of both varieties have a tendency finally to assume this form. It is formed when sulphur separates from its solutions at common temperatures. The second crystalline form is that of brownish yellow needles belonging to the oblique prismatic system. It is obtained by melting a mass of sulphur, allowing it to solidify on the surface, piercing the crust, and allowing the fluid portion to run out. On breaking away a part of the crust the long, needle-like crystals will be exposed to view. These two forms are not only very unlike as to their crystallography, but differ widely in their specific gravities and in their melting points, the octahedral crystals having a density of 2·05 and melting at 239° F., while the needles have a density of only 1·98, that of ordinary roll sul-

phur, and melt at 248°. After a time the prismatic crystals will be found to consist of aggregations of minute octahedral crystals. When a saturated solution of sulphur in hot turpentine cools, the first crystals formed will be prismatic, while those which are deposited when the solution is comparatively cool will be octahedrons. Roll sulphur or brimstone is at first prismatic, but after keeping becomes octahedral, and the change of form is attended with the evolution of heat. The amorphous variety of soluble sulphur is precipitated as a greenish white emulsion on adding acids to dilute solutions of alkaline polysulphides. This amorphous sulphur changes after a time into a mass of octahedral crystals. Ordinary sublimed sulphur (flowers of sulphur) belongs to this variety, but always contains small quantities of one of the insoluble modifications. The principal modifications of the insoluble variety of sulphur are: 1, an amorphous modification, obtained as a soft pasty mass, or magma, by decomposing bisulphide of chlorine with water, or by adding dilute hydrochloric acid to a solution of a hyposulphite; 2, a plastic form, obtained by pouring viscid sulphur raised to nearly 500° into cold water. The effect of heat upon sulphur is remarkable. It begins to melt at about 239°, and between 248° and 284° it is yellow, transparent, and limpid. As the temperature rises to 356° it becomes brown, and at last nearly black and opaque and quite viscid. At this point the temperature becomes stationary for a time, although the supply of heat is kept up, in consequence of a molecular change which is going on. Soon the temperature again rises, and when it has reached about 500° the mass becomes more liquid, but retains considerable viscosity. If it is now suddenly cooled by pouring it in a small stream into cold water, a brown tenacious mass is produced, which may be drawn out into elastic threads having a specific gravity of only 1·957. In a few hours it becomes yellow and opaque, and passes into the octahedral form. If the ductile sulphur is heated to 212°, the change is sudden, with a further rise of heat, from condensation, to 230°.—*Compounds.* Sulphur forms with oxygen an interesting series of compounds: two anhydrous oxides, or anhydrides, sulphurous anhydride, $SO_2$, and sulphuric anhydride, $SO_3$; two acids, sulphurous and sulphuric, formed by the union of these anhydrides respectively with water, and a further series of acids which have no corresponding anhydrides. The constitution of all these bodies is remarkably illustrative of the law of multiple proportions. The formulas of the acids are as follows:

| | |
|---|---|
| Hyposulphurous acid | $H_2SO_2$ |
| Sulphurous acid | $= SO_2+H_2O = H_2SO_3$ |
| Sulphuric acid | $= SO_3+H_2O = H_2SO_4$ |
| Thiosulphuric (sometimes called hyposulphuric) acid | $H_2S_2O_3$ |
| Dithionic acid | $H_2S_2O_6$ |
| Trithionic acid | $H_2S_3O_6$ |
| Tetrathionio acid | $H_2S_4O_6$ |
| Pentathionic acid | $H_2S_5O_6$ |

Thiosulphuric acid (Gr. θεῖον, sulphur) is so called because it has the constitution of sulphuric acid with a molecule of oxygen replaced by one of sulphur. The last four acids in the table are called polythionic acids, because they contain varying proportions of sulphur united with constant proportions of the other elements. Sulphurous anhydride, $SO_2$, formerly called sulphurous acid, is the only product when sulphur is burned in dry air or oxygen gas. When the combustion takes place in pure oxygen, it is found that on returning to its former temperature the gaseous product is doubled in weight, but that its volume is unchanged. It is in fact formed by the condensation of one volume of oxygen and half a volume of sulphur vapor into one volume. When required pure, sulphurous acid is usually obtained by the partial reduction of sulphuric acid. This is conveniently effected by boiling strong oil of vitriol with copper turnings or mercury. The reaction is shown in the following equation: $Cu + 2H_2SO_4 = CuSo_4 + 2H_2O + SO_2$. It may also be obtained by passing the vapor of sulphuric acid over red-hot platinum foil or sponge, the product being sulphurous anhydride and oxygen. (See Oxygen, vol. xii., p. 769.) Sulphurous anhydride is a colorless gas, having a density of 2·21. When subjected to a pressure of three atmospheres at common temperatures, or if cooled to 0° F. at the ordinary pressure, it is condensed to a colorless, transparent liquid, which solidifies to a crystalline mass at −105°. The liquid anhydride may be obtained in large quantities by passing the gas from the generator first through a small quantity of water to wash it, then through a tube surrounded by ice to remove moisture, then through a tube containing pieces of calcium chloride to dry it completely, and finally through a worm, or into a receiver immersed in a mixture of salt and ice. It may be preserved in sealed glass tubes, or corked and wired soda bottles. Sulphurous anhydride dissolves in water, forming a solution of sulphurous acid, $H_2SO_3$, which again decomposes by the application of gentle heat into the anhydride and water. Water at 60° absorbs about 45 times its volume of the gas, the resulting liquid having a density of 1·04. By exposure to the air the solution slowly passes into sulphuric acid. By cooling a saturated aqueous solution to 32°, Döpping obtained the pure acid, $H_2SO_3$, in cubical crystals. A crystalline hydrate, $SO_2SH_2O$, according to Pierre, may also be obtained at a low temperature, which melts at 39°, suffering decomposition. Sulphurous acid is a powerful reducing agent, instantly discoloring acid solutions of manganates and chromates, reducing the latter to green oxides of chromium. It reduces the salts of gold, precipitating the metal in the metallic state, and is capable of taking the second molecule of oxygen from almost any metallic binoxide. Brewers often employ a solution of sulphurous acid to wash out their beer

barrels, and in the rural districts sulphur is often burned in old cider barrels to purify them. Sulphurous acid is extensively used in bleaching straw, woollen, and silken goods, and also isinglass and other articles which would be injured by chlorine. (See BLEACHING.) It is a powerful antiseptic, and is now employed to preserve meats. (See PRESERVATION OF FOOD, vol. xiii., p. 824.) For its most important use, see SULPHURIC ACID. Sulphurous acid is dibasic, forming normal, neutral, and double salts. (See SULPHITES.) The binary compounds of sulphur with the metals, or the sulphides, are, when important, mentioned in the articles on the respective metals, or under SULPHIDES. One of the principal uses of sulphur is in making gunpowder. (See GUNPOWDER.)—*Medical Properties and Uses.* Sulphur is termed in therapeutics a laxative, diaphoretic, and alterative. It is supposed to be carried into the circulation by the fatty matters in the alimentary canal. That it is discharged by the skin is shown by the fact that silver worn about those who are taking it becomes blackened with a coating of sulphide. It is used in cutaneous and other diseases, both internally and externally, sometimes artificially prepared, and sometimes as it exists in natural springs. (See MINERAL SPRINGS.) It has been successfully employed in diphtheritic croup, given suspended in water, and in sciatica and chronic articular rheumatism, applied externally upon dry flannel and bandaged to the limb for several days. The officinal preparations embrace confections, plasters, and ointments, and precipitated sulphur or *lac sulphuris.* This latter preparation is made by boiling sulphur with milk of lime, which forms bisulphide of calcium and hyposulphite of lime, from the solutions of both of which the sulphur is precipitated by the action of hydrochloric acid. It has the general properties of ordinary sublimed sulphur, but is in a state of finer division.

**SULPHURETTED HYDROGEN.** See HYDROSULPHURIC ACID.

**SULPHURIC ACID,** the hydrate of sulphuric anhydride, or teroxide of sulphur, $SO_3 + H_2O = H_2SO_4$. It may also be regarded as a salt of hydrogen, this element holding the place of a basyle to the radical sulphion, $SO_4$. (See SALTS, vol. xiv., pp. 582, 583.) The discovery of sulphuric acid is ascribed to Basil Valentine, a monk of Erfurt in Saxony, about 1440. He obtained it by distilling green vitriol or the sulphate of iron, and as the liquid product had an oily appearance when poured out, it was called oil of vitriol. He also obtained it by burning sulphur under a bell glass containing moisture, calling the product *oleum sulphuris per campanum*, or oil of sulphur by the bell. This was the germ of the present process of manufacture, which consists in producing sulphurous acid and carrying it to a higher state of oxidation by nitrous and hyponitrous acids. The old process of distillation from green vitriol is still employed in some parts of Germany, particularly in the neighborhood of Nordhausen in Prussian Saxony, and near Prague in Bohemia. Sulphate of iron, chiefly produced by the oxidation of iron pyrites, first has its water of crystallization expelled, when it is subjected to a high

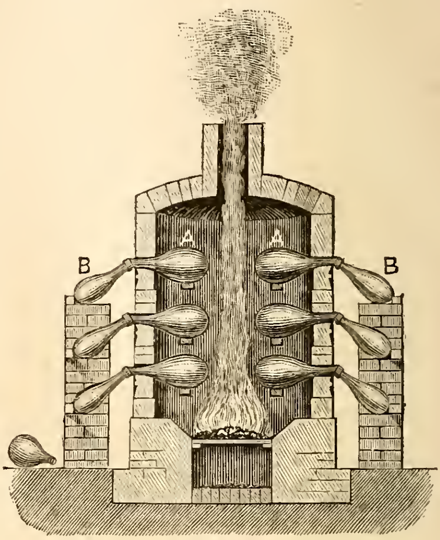



FIG. 1.—Distillation of Nordhausen Acid.

red heat in earthen retorts placed in galleries in a furnace, as shown in fig. 1. As soon as the acid begins to distil over, the necks of the retorts are passed into receivers. The product is a brown oily liquid having a density of about 1·9, and fumes in the air, for which reason it is also called fuming sulphuric acid. Its composition may be expressed by the formula $H_2SO_4,SO_3$. When gently heated it breaks up into sulphuric anhydride, $SO_3$, and sulphuric acid, $H_2SO_4$. If fuming Nordhausen acid is distilled into a receiver cooled by ice, white fumes will solidify on its sides into white silky needles. This product was formerly called anhydrous sulphuric acid. It does not however possess acid properties like the residue in the retort, but requires to be united with water to enable it to combine with bases. It is tough and ductile, and can be moulded in the fingers for a short time if they are dry. It has a specific gravity of 1·946 at 55·4°, fumes in the air, and when thrown into water hisses like red-hot iron, and forms sulphuric acid. It melts at 65° and boils at about 95°, forming a colorless vapor, which is decomposed in highly heated porcelain tubes into two volumes of sulphurous anhydride and oxygen. The common way of preparing sulphuric acid at present, known as the English process, is to oxidize sulphurous acid. It is said to have been introduced by Dr. Roebuck about the middle of the 18th century, but the invention is also

claimed for a calico printer at Rouen, with improvements by Chaptal, such claimants giving credit to Dr. Roebuck only for the invention of the leaden chambers in which the process was carried on. A large and long chamber, divided into sections by partitions which alternately leave open spaces at the top and bottom, has at one end a small furnace in which the flame of sulphur heats a crucible containing a mixture of nitre and oil of vitriol. The chamber is lined with sheet lead, and its floor is covered with a thin stratum of water. Jets of steam are also introduced. The sulphur in burning produces sulphurous anhydride, $SO_2$, which in the presence of moisture becomes sulphurous acid ($SO_2+H_2O=H_2SO_3$), and this again, by the action of $NO_5$, becomes sulphuric acid, $H_2SO_4$, the nitric acid being at the same time reduced to a lower oxide. According to the researches of Weber and Winkler, the following is the rationale of the process: The oxidation of the sulphurous acid to sulphuric acid takes place in the leaden chambers under the influence of the vapor of water, at the expense of the oxygen of the nitric or nitrous acid, which is converted into deutoxide of nitrogen. It is necessary however that the nitrous acid be first absorbed in plenty of water, which takes up the free nitrous acid and decomposes the deutoxide of nitrogen, a process greatly promoted by the presence in the chamber of sulphurous acid purposely introduced. The water, usually in the form of steam (practical experience proving that a certain elevation of temperature is required), acts in this process as in others wherein sulphurous acid effects reduction. By the presence of atmospheric air in the chamber the deutoxide of nitrogen is oxidized into hyponitric or nitrous acid, and this acid again is decomposed by sulphurous acid. A peculiar crystalline substance sometimes forms, having the formula $H_2SO_4+N_2O_3,SO_3$, and formerly thought to play an important part in the transformation; but according to R. Weber this substance only appears when the process is not well managed, and is chiefly due to want of water. The process of forming sulphuric acid may be illustrated on a small scale by means of the apparatus shown in fig. 2. A flask, *b*, furnishes sulphurous anhydride, and the bottle *e* deutoxide of nitrogen, to the large glass balloon *r*, and the flask *w* supplies steam when it is required. Air is occasionally blown into the balloon through the bent tube *t*, the effete products passing out at *o*. If but little vapor of water is present, the white crystalline solid above mentioned makes its appearance upon the sides of the globe; but when sufficient water is present the substance is not deposited, neither is it supposed to be formed as a necessary stage of the process. Gay-Lussac invented what is called a condenser as an attachment to the large leaden chambers, for the purpose of economizing the consumption of nitre, which formerly amounted to from one eighth to one twelfth of the weight of sulphur. The condenser consists of a leaden tower filled with fragments of coke, through which sulphuric acid of 66° Baumé is constantly trickling. Through this condenser the spent gases are passed, and the oxides of nitrogen which they may contain are absorbed. The sulphuric acid which collects at the bottom of the chambers is too dilute for most purposes; it is not found advantageous to allow it to attain a specific gravity of quite 1·6, because at that strength it absorbs too much of the nitrous fumes. It may be used at this strength for the manufacture of salt cake (see SODA), but for other uses it must be further concentrated. This is generally effected by two different stages, the first in leaden pans, the second in platinum or glass retorts. Some makers concentrate to 60° Baumé (sp. gr. 1·71) in leaden pans; others use them only till the acid is raised to 55° Baumé (sp. gr. 1·59). The leaden pans are rectangular, long and wide, supported by iron plates to protect the lead from immediate contact with the flame which is used for evaporation. The pans are generally arranged in steps, the acid being conveyed from the upper to the lower ones by syphons, the density of the acid increasing from one pan to the next lower. When it has attained a density of from 1·65 to 1·72 in the leaden pans, it is known as brown oil of vitriol, and may be used by bleachers, calico printers, dyers, &c.; but to raise it to the strength of commercial oil of vitriol, it is further concentrated in the glass or platinum retorts above mentioned. Glass retorts holding 20 gallons or more are often used, set in an iron pot, the bottom of which is covered with dry sand. The concentration requires from 12 to 16 hours; the vapors which distil over toward the last, carrying some acid with them, are passed into condensers and returned to the lead pans. Platinum retorts are more costly, but are thought by many to be more economical in the end on account of their not being liable to break. Fig. 3 shows a section of a platinum retort. The syphon *x* is worked without a stopcock by the vessel *c*, in the following ingenious manner. When the vessel is lowered

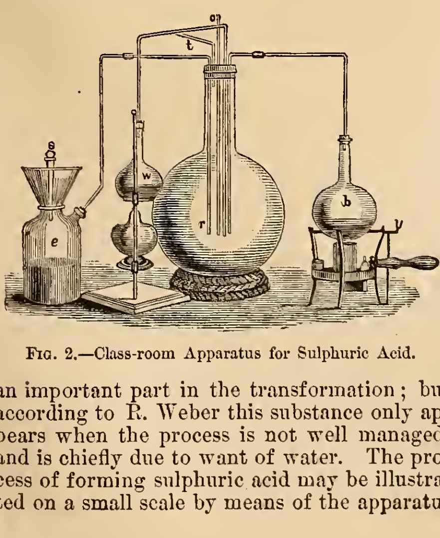


FIG. 2.—Class-room Apparatus for Sulphuric Acid.

with its spout to the gutter *d*, the outer limb of the syphon, which is constantly full, becomes lengthened below *n* (the end of one of the leaden pans), and the acid flows out, fills the movable vessel, and runs out of the spout and through the gutter *d* into the retort B. The

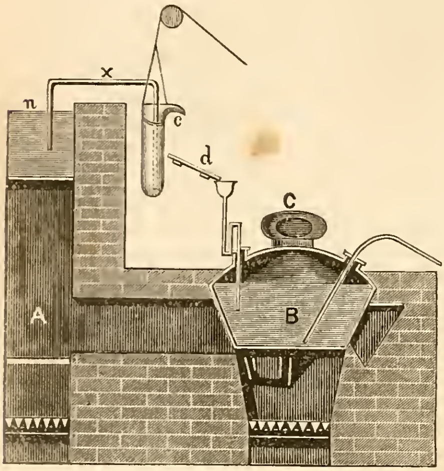


FIG. 3.—Platinum Retort.

head C communicates by means of tubing, not shown in the engraving, with a worm, where the watery vapor and the very weak acid mechanically carried over with it are condensed. The fire under the retort communicates with the flue A, which passes under the leaden pans. The concentrated acid left in the retorts contains a slight excess of water beyond that required for the formula $H_2O,SO^3$ or $H_2SO_4$. This formula gives 18·36 per cent. of the elements of water, while Marignac obtained 19·62 per cent. from the concentrated acid. According to Playfair, if the concentration is conducted at a temperature not exceeding 500° F., the true compound, of sp. gr. 1·844, is obtained; but if heated to ebullition, there is partial decomposition.—*Properties.* The oil of vitriol of commerce is an oily-looking, colorless, and odorless liquid, of sp. gr. 1·842. It chars nearly all organic substances, in consequence of abstracting from them the elements of water, leaving a carbonaceous residue. It mixes with water in all proportions, with condensation of volume of the mixture, and consequent evolution of heat. Its attraction for moisture is so great, that if exposed to the air for a few days in a shallow vessel it frequently doubles its weight; and advantage is taken of this in the laboratory for drying various substances. The boiling point of sulphuric acid is 620·6° F., and it freezes at about −29°, although when frozen it does not melt below 32°. Marignac finds that the true sulphuric acid when heated parts with a small quantity of vapor of the anhydride, and the remaining liquid boils at 640·4°. Sulphuric acid forms two definite hydrates, the monohydrate, $H_2SO_4,H_2O$, and the dihydrate, $H_2SO_4,2H_2O$. The first, of sp. gr. 1·78, crystallizes at 47° in splendid rhombic prisms, of sp. gr. 1·951. From this property it is often called glacial sulphuric acid. It boils at about 400°. The dihydrate may be formed by concentrating a dilute acid *in vacuo* at 212° till it ceases to lose weight. Its sp. gr. is 1·62; boiling point, 370°.—*Uses.* Sulphuric acid is the starting point of nearly all the great chemical manufactures. It is used to procure nitric acid from the nitrates of potassium and sodium, and hydrochloric acid from common salt, at the same time furnishing salt cake, from which the carbonates of soda are obtained. It is therefore used in the preparation of various bleaching compounds. Phosphate of lime in artificial manures is reduced to biphosphate by the action of sulphuric acid. In medicine, diluted with water or spirits of wine and known as *acidum sulphuricum dilutum* and *acidum sulphuricum aromaticum*, it is used as a tonic, refrigerant, and astringent. It is given in typhoid fevers, in convalescence from various fevers, and as an aid to digestion.

**SULPHURIC ETHER.** See ETHER.

**SULPHUROUS ACID.** See SULPHUR.

**SULPICIANS, or Priests of the Society of St. Sulpice,** a congregation of priests in the Roman Catholic church founded in the parish of St. Sulpice, Paris, in 1645, by Jean Jacques Olier de Verneuil, and specially devoted to the training of candidates for the priesthood. In 1642 Olier and two other clergymen formed a community at Vaugirard, and bound themselves to found ecclesiastical seminaries. His companions soon abandoned him, and becoming in the same year rector of the parish of St. Sulpice, he set about realizing his plan there. The act founding the society of St. Sulpice is dated Sept. 6, 1645, and was immediately sanctioned by the proper authorities. The corner stone of the present seminary of St. Sulpice was laid in September, 1649; the edifice was completed and occupied in August, 1651. The society formed two bands, the one devoted to parish work, the other to that of teaching. The Sulpicians were warmly befriended from the beginning by St. Vincent de Paul, and the establishment of Sulpician seminaries in nearly all the dioceses of France soon followed. Thereby the society came to have the chief part in the education of the French clergy down to the revolution of 1789. They were at first favored by Napoleon, but were suppressed by him in 1812 for their attachment to Pius VII.; they were restored by Louis XVIII., and ever afterward directed the most important diocesan seminaries in France.—Olier in 1636 formed a company for colonizing the island of Montreal. They purchased it in 1640, sent out Sieur de Maisonneuve with priests and nuns in 1641, and transferred their proprietorship to the Sulpicians in 1656. In 1657 the Sulpicians De Queylus, Souard, and Galinier took possession of

the island and founded there a missionary establishment; but their claims to exclusive parochial jurisdiction being resisted, De Queylus in 1659 obtained in Rome a bull erecting Montreal into an independent parish, and used the powers thus conferred in spite of Bishop de Laval, till a *lettre de cachet* forcibly removed him in October, 1660. This conflict of jurisdiction broke out anew in 1821, on the erection of the see of Montreal, and has been kept up till the present time, the most eminent Canadian jurists taking sides in the controversy. Both parties appealed to Rome, and a final decision had not been reached in the beginning of 1876. The Sulpicians François de Fénelon, brother of the author of *Télémaque*, and Claude Trouvé, founded in 1668 the first Iroquois mission at the western extremity of Lake Ontario. In July, 1669, a party of Sulpicians under Dollier de Casson first explored Lake Erie and sailed round it and Lake St. Clair. But their missionary labors were soon necessarily limited to the Indian tribes in the immediate neighborhood of Montreal, where they collected the remnants of the Christian Algonquin and Iroquois tribes into two contiguous settlements at the lake of Two Mountains on the Ottawa. In Montreal city, besides the seminary proper attached to the church of Notre Dame as a parochial residence, founded in 1657, they possess the theological seminary, to which students are sent from every part of the United States, the preparatory seminary or "college of Montreal," founded in 1773, and several other succursal churches with their residences.—In April, 1791, at the call of Bishop (afterward Archbishop) Carroll, a band of four Sulpicians and three seminarians, headed by François Charles Nagot (died 1816), sailed for Baltimore, where they formed for a time the clergy of the cathedral. They sent some of their number to teach in Georgetown college, and founded in Baltimore the theological seminary of St. Mary's, with a collegiate or preparatory school. The seminary was raised by Pope Gregory XVI. to the rank of a Catholic university; the collegiate school was removed to near Ellicott City, Howard co., in 1849, and suppressed in 1852.

**SULPICIUS SEVERUS**, a Roman historian, born near Toulouse about A. D. 363, died at Marseilles about 410. He was a lawyer, but on the death of his wife adopted an ascetic life. His father disinherited him; but, encouraged and assisted by his father-in-law, he formed with his own freedmen and a few followers a monastic establishment near Marseilles. He wrote the life of St. Martin of Tours, an abridgment of the Scriptural narrative, which was a favorite text book in the schools of the middle ages, and a continuation to his own time, under the title of "The Chronicle of Sulpicius Severus." His works, which have been often printed, include also "Three Dialogues" and a collection of letters. The last critical edition is that of Halm, forming vol. i. of the Vienna *Corpus* (1866).

**SUMACH**, or **Sumac** (Arab. *summak*), the common name for plants of the genus *rhus* (the ancient Greek and Latin name), of the cashew family or *anacardiaceæ*, which includes, besides the cashew, the mango and other tropical fruits. The sumachs are represented in the United States by about 12 species, which are shrubs or small trees, with alternate, sometimes simple, but generally trifoliolate or odd-pinnate leaves, and small polygamous flowers in terminal or axillary panicles; the sepals and petals are five, and the stamens, also five, are inserted under the margin of a disk which lines the calyx; fruit a small, dry, nut-like drupe. Our species are separable into several well marked sections or subgenera. 1. The sumachs proper, with pinnate leaves, flowers in a terminal crowded panicle, and the globular fruit clothed with acid hairs; the plants not poisonous, and containing an abundance of tannin. The smooth sumach (*rhus glabra*) is the most common, often covering extensive tracts of barren soil; it grows from 2 to 12 ft. high, with leaves a foot or more long, consisting of 11 to 31 lance-oblong, pointed, serrate leaflets, which are whitish beneath; the yellowish green flowers appear in June, and are pleasantly fragrant; the fruit, in dense clusters, is of the richest crimson, with a velvety appearance from the number of small hairs; it has a pleasant acid taste, due to the presence of a great abundance of bimalate of lime; an infusion of the berries is sometimes used to make a cooling drink in fevers, and as a gargle in affections of the throat and mouth. The leaves of this species are among the first which put on autumn colors, and

Smooth Sumach (Rhus glabra).

show fine tints of yellow and scarlet; a variety in which the leaflets are much subdivided, discovered some years ago in Pennsylvania, is in cultivation for the fern-like beauty of its foliage under the name of cut-leaved sumach. The stag's-horn sumach (*R. typhina*) is the

largest of the northern species, sometimes reaching 30 ft., but is usually about 10 ft.; it is readily distinguished from the preceding by the copious soft velvety down which clothes the ends of the branches; the wood and abundant pith are yellowish or orange-colored; the clusters of fruit, at first crimson, turn purple in autumn; they have the same acid properties as the foregoing. The dwarf or mountain sumach (*R. copallina*) is a remarkably neat shrub, seldom more than 6 or 8 ft. high; the branches are downy, but less conspicuously so than in the stag's-horn sumach, and it is readily distinguished from either of the others by its dark shining leaves, the common petiole to which bears a winged margin; the leaves in autumn turn to a rich purple; fruit similar to the preceding. A very dwarf species of this section, *R. pumila*, with branches only about a foot high, is found from North Carolina southward in pine barrens; this has been erroneously described as poisonous. 2. The section *lobadium* includes species in which the flowers are in short ament-like spikes preceding the leaves, fruit flattish, and leaves of three leaflets, not poisonous. The principal species is the fragrant sumach (*R. aromatica*), a straggling bush 4 or 5 ft. high; its range is from Vermont to Florida, and westward to the Rocky mountains, where it has smaller leaves and has been described as a distinct species (*R. trilobata*). The leaves of the eastern form are pleasantly fragrant when bruised, and those of the western have a strong and heavy odor; they with other leaves form the kinnikinick or killikinick, smoked by the Indians as a substitute for tobacco. 3. The section *cotinus* has simple leaves, not poisonous, and flowers in loose panicles. This is represented by the well known Venetian sumach, or smoke tree of the gardens (*R. cotinus*), sometimes

Venetian Sumach (Rhus cotinus). Fruitful and abortive pedicels, reduced and of full size.

called by nurserymen the purple fringe tree; it is a native of southern Europe, and is rarely over 10 or 12 ft. high; in summer it is nearly enveloped in large, feathery, cloud-like masses, which are at first greenish and later tinged with red; this very showy effect is produced by the little pedicels or stalks of the flower cluster, very few of which bear flowers and fruit, while the abortive ones lengthen greatly, branch, and become plumose with long hairs. This plant was known to the ancients, and has long been used in Greece and other countries for tanning and dyeing. A tree closely resembling this, found in the interior of Alabama, and described by Nuttall as a distinct species (*R. cotinoides*), is so little known that it is not yet admitted as really different. 4. The *toxicodendron* group includes two species with white or dun-colored berries in loose panicles and highly poisonous foliage. The

Poison Ivy (Rhus toxicodendron).

poison ivy or poison oak (*R. toxicodendron*) is also in some localities called mercury vine; it has leaves of three leaflets, which are rhombic ovate, and variously notched, lobed, or even entire; its flowers are in loose slender axillary panicles; the smooth fruit is pale brown. This is found nearly all over the country, especially in moist and shady places, and presents two forms, one erect and the other climbing, which were formerly described as distinct species, but run into one another in such a manner that they can hardly be regarded as varieties; it clambers over rocks and fences, and by means of aërial rootlets ascends the trunks of the tallest trees, and adheres with great pertinacity; when wounded it exudes a milky juice, which becomes black upon exposure to the air, and upon fabrics makes a stain indelible by all ordinary solvents; the leaves taken internally promote the secretions of the skin and kidneys. This plant is highly poisonous to many persons. The poison sumach (*R. venenata*), also often called poison dogwood and poison elder, is an exceedingly neat and graceful shrub, 6 to 18 ft. high, found in swamps from Canada to Louisiana; the young shoots are purple, or green clouded

with purple, and marked by orange-colored dots which turn grayish; the leaves have 7 to 13 leaflets, which are dark green, pointed, and entire on the margins; the greenish yellow

Poison Sumach (Rhus venenata).

flowers are in loose axillary panicles, and the greenish white fruit hangs in loose clusters on stems 6 or 8 in. long, and remains after the leaves have fallen; the juice is milky, and dries to a black varnish. This has poisonous characters similar to the preceding, but is much more virulent. The susceptibility to the poison varies greatly in different persons; many can handle the plants without any unpleasant results, while others are seriously affected by touching them, or even passing near them. The poisonous properties of these plants are due to a volatile acid named by its discoverer, Prof. J. M. Maisch, toxicodendric. Its effect is an acute eczematous inflammation of the skin, often accompanied by much swelling. The usual remedies are cooling saline purgatives and an external application of lead water. The coral sumach (*R. metopium*), a native of the West Indies, is found in the southernmost parts of Florida; it is a tree 15 to 20 ft. high, with leaves of three to seven thick leaflets, and loose clusters of scarlet berries the size of peas; this also is poisonous.—The sumach of commerce formerly consisted entirely of the imported leaves of *rhus coriaria* of southern Europe and northern Africa; it greatly resembles in appearance our stag's-horn sumach (*R. typhina*), and like that forms a small tree; it is largely cultivated in Sicily, where the suckers are planted in rows about 4 ft. apart, and the shoots are yearly cut back to within a few inches of the ground, the crop for the next year being furnished by the new stems which push from the stumps; the shoots are dried and threshed, the leaves are finally ground between mill stones and bolted, and the powder is put into sacks of 163 lbs. each for shipment; the product is sometimes adulterated with other leaves, but when pure contains from 30 to 35 per cent. of tannin. Sumach is used for tanning light-colored leathers and in dyeing and calico printing; it yields with different mordants a great variety of tints. Since the civil war the collection and preparation of the leaves of our native sumachs have assumed considerable importance, especially in Virginia, the headquarters of the industry being at Richmond. The plants grow so abundantly in the wild state that cultivation has not been attempted; the smooth, the stag's-horn, and the mountain sumachs are collected indiscriminately, but as the first named is the most abundant, the product consists mainly of that; the gathering begins early in July and continues till frost. The leafy tops of the plants are broken off and carefully dried, the best being that dried in the shade; when dry it is beaten with sticks, and the leaves are taken to the mill to receive the same treatment as that described for Sicilian sumach. American sumach contains from 15 to 20 per cent. or more of tannin.—The Japan wax, or vegetable wax of Japan, is yielded by *rhus succedanea*, being found as a thick white coating of the seed within the capsule. To extract it, the bruised seed vessels are boiled in water and the wax skimmed off as it rises to the top; it has much the appearance of white wax (bleached beeswax), but is rather more opaque; it melts at about 127°, saponifies readily, and formed into candles gives a fine clear light; mixed in proper proportions with paraffine, it makes a candle in appearance closely resembling one of wax.—The lacquer of the Japanese is produced by *R. vernicifera*, a shrub so nearly like our poison sumach in appearance and in poisonous qualities that the two were at one time supposed to be identical. The juice, obtained by wounding the tree, is at first milky, but becomes black on exposure, and is largely used for furniture and various kinds of woodwork. Americans in Japan have become seriously poisoned by coming in contact with newly varnished wares. Dr. Jacob Bigelow many years ago demonstrated that our poison sumach affords a similar product. Other and poisonous species afford lacquer to the

Chinese Galls (Rhus semialata).

natives of China and India.—The singularly shaped Chinese galls are the result of the puncture and deposition of the egg of an insect in the leaf stalks and young shoots of a sumach,

*rhus semialata*, of northern India, China, and Japan; the galls are very irregular in shape, 1 to 2½ in. long, mostly egg-shaped, with various knotty protuberances, and often lobed, velvety with a gray down; they are more brittle shells about $\frac{1}{20}$ in. thick, breaking with a shining fracture, and containing about 70 per cent. of tannin. In 1872, 8,621 cwt. of these galls were imported into Great Britain alone.

**SUMAROKOFF, Alexei Petrovitch**, a Russian dramatist, born in Moscow in November, 1727, died there in October, 1777. He was educated at St. Petersburg, and the empress Elizabeth placed him in the school of cadets. In 1756 he founded the first national theatre at St. Petersburg, and became its director with the rank of brigadier general. Catharine II. made him councillor of state. He modelled his plays after Corneille, Racine, and Voltaire. Among his tragedies are *Khoreff* and *Sinaff i Truvor.* He also wrote prose works, satires, and other poetry. His complete writings (10 vols., 1787) have passed through several editions.

**SUMATRA** (Sans. *Samudra*, the ocean), an island of the Indian archipelago, in the Indo-Malay group, lying directly under the equator, S. W. of the Malay peninsula and parallel to it, between lat. 5° 40′ N. and 5° 55′ S., and lon. 95° 20′ and 106° 5′ E.; bounded N. by the bay of Bengal, N. E. by the strait of Malacca, E. by the China sea, the strait of Banca, and the Java sea, S. by the strait of Sunda, and S. W. by the Indian ocean; extreme length 1,050 m., greatest breadth 250 m.; area, 160,000 sq. m.; pop. estimated at from 3,000,000 to 4,000,000. About three fourths of the island is subject to the Netherlands, a portion directly, and the rest through dependent native rulers. To the first class belong four colonial establishments, which include the adjoining islands: 1. The government officially known as Sumatra's West Coast, comprising the western seaboard from lat. 2° 30′ N. to 1° 55′ S., and including the residencies of Tapanuli and Padang; aggregate area, about 47,000 sq. m.; pop. in 1872, 1,620,979. 2. Bencoolen, on the S. W. coast, described under its own title. 3. Lampong, at the S. extremity of the island; area, 10,000 sq. m.; pop. 112,271. 4. Palembang, on the S. E. coast opposite Banca. (See Palembang.) The principal native state in Sumatra is Acheen, which embraces the northern end of the island from coast to coast, and is wholly independent of the Dutch. (See Acheen.) The territory of the cannibal Bataks extends southward from Acheen, along the interior, to the border of the colonial districts of the W. coast. The largest native countries in the east are Siak, opposite the S. extremity of Malacca, and Jambi, between Siak and the Dutch residency of Palembang.—The physical conformation of Sumatra resembles that of Java in the long volcanic range which extends throughout the island, although the active volcanoes are not nearly so numerous, and probably do not exceed five. The range is near the W. coast, from which it is separated by a strip of lowlands from less than 20 to 30 m. wide, above which the mountains rise abruptly to a height of from 2,500 to 5,000 ft., with many lofty peaks. They form four or five parallel ridges with elevated plateaus between them. There are four summits over 10,000 ft. high, and six others over 5,000 ft. Mt. Berapi, just S. of the equator (12,000 ft.), is the centre of a volcanic district containing numerous hot springs, and continually emits vapor. The altitude of Mt. Ophir (or Passaman peak), at the equator, and Mt. Indrapura, in lat. 1° 30′ S., is estimated at upward of 12,000 ft., and a height of 11,000 ft. is assigned to the Abong-Abong mountain, which rises from the very centre of the unexplored interior of Acheen. The portion of Sumatra which lies eastward of the great linear volcanic range is a vast low and comparatively level forest region, watered by numerous and extensive rivers, and subject to frequent inundation near the coast. The formation of this great plain is alluvial, and comparatively recent in geological time, while the W. coast is believed to be gradually wearing away. According to Wallace, Sumatra was formerly connected with the Malay peninsula, and also with Borneo. In western Sumatra the underlying formation consists of granite and syenite, overspread with mud and coral, sandstone, and lava and other volcanic products. Limestone and marble occur in Padang, and there are extensive coal beds in the island, but of very recent origin. Sumatra has long been noted for its yield of gold, which is still considerable, being derived from the beds of the rivers, particularly the Indragiri, the Jambi, and their tributaries. Iron, copper, tin, sulphur, and petroleum are also found.—The coast is about 2,500 m. in circuit. The island terminates on the northwest in Acheen head and on the northeast in Diamond point. Between these points stretches the N. coast of Acheen, formerly known as the Pedir coast, on which is the town of Passier, believed to be the first place to which the name *Samuthrah* (Sumatra) was applied. The shore is high and bold, and the anchorage is mostly in open roadsteads. The N. E. coast is low, and from the narrowest part of the strait of Malacca southward to the strait of Sunda it is bordered by extensive banks of mud and sand, making navigation intricate and dangerous. The entire W. coast is exposed to a very heavy surf, and more especially that portion which lies S. of the equator. It is indented by several excellent harbors, that of Tapanuli being considered one of the finest in the world. Parallel to it and about 60 m. distant is a chain of islands, between lat. 3° N. and 5° 30′ S., comprising several of considerable size, including Pulo Babi or Hog island (50 m. long), Pulo Nias (70 m.), Sibiru, Sipora, the Poggi islands, and Engano. Most of them are high, well wooded, and thickly inhabited. The chief islands off the E. coast


SUMATRA, BORNEO, PAPUA,

AND ADJACENT ISLANDS.


153
143
133
20
10
0
10
130
140
150
m Greenwich
Los Jardines or Marshall Is.
Peru or 3 Is.
Uraccas or Mangs Is.
Lindsay
Asuncion
Grigan
Pagon I.
Alamaguan
Guguan
MARIANNE OR LADRONE ISLANDS
Farallon de Torres
Sariguan
Anntajau
Bird I.
Seypan
Tinian or Buena Vista
Rota or Sarpan
Guam
PACIFIC OCEAN
CAROLINE IS.
Uluthi or Mackenzie Is.
Thorollen
Elivi Is.
Uap
Hilap
Feys or Tromelin
Namunuito or Lütke Is.
Hall Is.
Duncan Reef
Segueiras
Gulu or Matelotas Is.
Sorol or Philip Is.
Lydia
Bigall
Pelew Is.
Babelthuap
Swede Is.
Los Martires
Moenn
Hogoln
Tol
or Rug
Ullie
Ifuluk or Wilson Is.
Enderby Is.
Royalist
Lusap or D'Urville
Euripig or Kama Is.
Pulusak
Ianthe Shoal
Mortlock Is.
St. Andrew Is.
Monteverde Is.
PHILIPPINE ISLANDS
MINDANAO
Surigao Is.
Davao B.
Tulur Is.
Morty
Moluccas or Spice Is.
Passage
Gilolo
Ternate
Tidore
St. David or Freewill Is.
C. of Good Hope
Waigiou
Equator
Dampier Str.
Salawaty
Misol
Oby
Sawaai
Ceram
Amboyna
Goram
Banda Is.
Turtle Is.
BANDA SEA
Mysore Is.
Jobie
Dorey
Vlakke C.
Arfak Mts.
Gt. Geelvink Bay
Mc. Cluer Inlet
R. Van Goene B.
Laut Is.
Adi
Kei Is.
Triton B.
Etna B.
Snowy Mts
Timakora or Timoraka
Princess Marianne Str.
Dobba
Kobror
Aroe Is. (Arru Is.)
Tenimber Is. or Timur Laut
Nila
Damme
Wetter
Roma
Serwatti Is.
Babbar
Sermatta
Moa
Prince Frederick Henry I.
False C.
ARAFURA SEA
C. Ambernoh or Pte d'Urville
Walckenaer B.
Humboldt B.
L'Echiquier Is.
Anchorites Is.
Admiralty Is.
St. Matthias
Byron Strait
Lyra Shoal
d'Urville Is.
Purdy Is.
Schouten Is.
New Hanover
Fisher I.
NEW IRELAND (Tombara)
St. John
Sir C. Hardy
C. St. George
St. George Ch.
Cornelis B.
PAPUA OR NEW GUINEA
Dampier I.
Sherburne Reef
Dampier Str.
French Is.
Astrolabe B.
Willaumez I.
Wide B.
NEW BRITAIN (Birara)
Finisterre Mts.
C. King William
Huon G.
Riche I.
Port Montague
S. Cape
Bougainville
Gulf of Papua
Mt. Owen Stanley
Stanley Range
S.E. Cape
Trobriand Is.
Woodlark I.
D'Entrecasteaux Is.
TORRES STRAIT
Banks I.
Pr. of Wales I.
C. York
Melville I.
Dundas Str.
Bathurst I.
Van Diemen G.
Pt. Dale
Wessel Is.
Arnhem B.
C. Arnhem
GULF OF CARPENTARIA
Anson B.
Queens Ch.
Cambridge Gulf
Groote Eylandt
Sir E. Pellew Is.
Wellesley Is.
Mornington I.
York Peninsula
C. Grenville
Princess Charlotte B.
C. Melville
C. Flattery
Trinity B.
C. Grafton
Hinchinbrook I.
Great Barrier Reefs
Cloudy B.
Heath B.
Sudest
Rossel
AUSTRALIA


SUMATRA, BORNEO, PAPUA,
AND ADJACENT ISLANDS.
Dutch
Spanish
Native
Portuguese
East Longitude West from Washington
Longitude East from Greenwich
CHINA
BURMAH
SIAM
ANNAM
CAMBODIA
PHILIPPINE ISLANDS
LUZON
MINDANAO
CELEBES
BORNEO
JAVA SEA
BANDA SEA
FLORIS SEA
ARAFURA SEA
SOOLOO SEA
CHINA SEA
CELEBES SEA
PACIFIC OCEAN
CAROLINE IS.
MARIANNE OR LADRONE ISLANDS
PAPUA OR NEW GUINEA
NEW BRITAIN
NEW IRELAND
SUNDA ISLANDS
INDIAN OCEAN
AUSTRALIA
GULF OF CARPENTARIA
TORRES STRAIT
Equator
Formosa
Hainan
Hong Kong
Canton
Bangkok
Saigon
Manila
Singapore
Malacca
Sarawak
Batavia
Macassar
Timor
Pulo Nias
Bencoolen
Sumba
Sumbawa
Lombock
Bali
Madura
Banca
Billiton
Palawan
Mindoro
Samar
Leyte
Negros
Gilolo
Ceram
Boeroe
Amboyna
Aroe Is.
Timor Laut
Admiralty Is.
Louisiade
Cape York
York Peninsula
Great Barrier Reefs
Arnhem
Groote Eylandt
Wellesley Is.
Guam
Pelew Is.

are Banca and Rupat, the latter in lat. 2° N., extending about 25 m. each way, and separated from Sumatra by a narrow strait, only navigable by small vessels.—The large rivers of Sumatra flow down the eastern watershed, and although there are many rivers on the W. coast, they all have short courses and are very rapid. The principal eastern watercourses are the Rakan, flowing northward from the equator; the Siak, 200 m. long, in the native state of Siak; the Kamper, still further S.; the Indragiri, having a general eastward course not far from the 1st parallel of S. latitude, and said to be 300 m. long; the Jambi, in the country of that name; and the Musi or Palembang, falling into the strait of Banca, the largest river in Sumatra and navigable 200 m. inland. In the lower part of their courses these rivers are very sluggish, and they all have extensive deltas. Among the mountains in the west are several lakes, of which the best known is Sinkara, nearly 1° S. of the equator, at a height of 1,700 ft. above the sea. It is 10 m. long, 3 m. broad, and 1,182 ft. deep. The Manindyu lake, in the same region, occupies the elliptic crater of an extinct volcano, and is 6 m. long by 4 m. in width, with a depth of 2,060 ft.—The climate of Sumatra is warm and moist, the thermometer ranging throughout the year between 76° and 93°. There are about 200 days of rain in the year on the Padang plateau, 2,400 ft. above the ocean. During the N. W. monsoon, which blows from November to January, the weather is excessively rainy; but from June to September, when the S. E. monsoon prevails, the rainfall is limited to showers. Except in the marshy districts, the coasts are moderately healthful. Sumatra is overspread with vast forests, rich in the most valuable products of the tropics. Much of the E. coast is covered with mangrove bushes. Further inland are found palms, and trees of gigantic growth, many of them being more than 100 ft. high. On the W. shore, besides the myrtle and several varieties of fig, all the fruit trees common to the archipelago abound, and most of the mountains are covered to their summits with jungle. In the forests are many valuable timber trees, immense tree ferns, bamboos, rattans, the camphor tree, caoutchouc, and benzoin. The parasitic *Rafflesia* bears a flower with a calyx a yard in diameter. The soil of Sumatra is remarkable for its fertility, and yields large and valuable crops of rice, coffee, pepper, and tobacco, and some cotton. The cocoanut tree, the betelnut, and the sago palm also afford important products. There is a considerable export of coffee to the United States from Padang, where it is grown on the plateau. In Acheen pepper is the chief crop.—The Sumatran fauna corresponds closely with that of Java and Borneo, the other great islands of the Indo-Malay group. Of the quadrumana it comprises 11 species, among them the siamang ape, and the orang-outang, whose sole other habitat is Borneo; it is believed to be confined to the N. W. portion of Sumatra. The tiger, the two-horned rhinoceros, and the elephant (*E. Sumatranus*) are all found on the island. Many elephants were tamed in former times, but no attempt is now made to domesticate them. Other mammals are the musk deer and great Malay deer, the tapir, the flying lemur, the Malayan sun bear, squirrels, and bats. There are many beautiful pheasants, parrots, partridges, woodpeckers, herons, and the large hornbill. Crocodiles and pythons are the most formidable reptiles. The forms of insect life are numerous and varied, including 21 *papilionidæ*, among which is the leaf butterfly. In many parts of the island travelling is rendered uncomfortable by swarms of leeches and mosquitoes. Buffaloes, horses, goats, and Chinese pigs are the common domestic animals.—The inhabitants of Sumatra are of the Malay race, of which the island is supposed to have been the cradle. They are divided into several tribes, who speak languages that are considered as dialects of one common tongue. There are tribes in the interior whose origin is involved in obscurity. The people of the N. part of Sumatra, about Acheen, are taller, stouter, and of darker complexion than the other tribes, and are supposed to have a considerable infusion of Hindoo blood. The Bataks or Battas, who occupy the country immediately S. of these people, are smaller and of lighter complexion, and in some respects a very singular race. (See Batak.) Mohammedanism is the prevailing religion, but it is in a relaxed state, and the people of the interior cannot be said to belong to any particular faith. Polygamy is not common except among the chiefs. The Malays round the coast appear to be collected from different parts of the archipelago, and it is estimated that more than 6,000 Chinese have settled in the Dutch possessions. Among the natives the ordinary dress is a turban and loose trowsers reaching to the knee; the upper part of the body is commonly uncovered in both sexes, but a scarf is sometimes worn about the shoulders. The houses are raised on posts or pillars from 4 to 8 ft. from the ground, and in some parts of the country they are erected in trees. Those of the poorer classes are made of bamboo and thatched with grass, but the houses of the more wealthy are generally framed of wood and the sides enclosed by large sheets of bark. Agriculture is in a very rude state. The only important manufactures are of utensils and cloth for domestic purposes. Iron for native use is now wholly imported. The trade of Sumatra is principally carried on with Java, Madura, Singapore, Malacca, Penang, and British India. The chief exports are pepper, gold dust, camphor, nutmegs, cloves, mace, benzoin, gutta percha, copper, tin, sulphur, and coral. —For administrative purposes the Dutch colonial possessions are divided into districts, each under a controller, who visits the various villages from time to time. The native inhabi-

tants are forbidden to bear firearms. The entire number of Europeans in the country probably does not exceed 2,000. The chief towns are Acheen in the north, Palembang in the southeast, Bencoolen in the southwest, and Padang on the W. coast.—The first historical notice of Sumatra occurs in Arab manuscripts narrating voyages made thither in the 9th century. The island was visited in 1292 by Marco Polo, who described it very accurately under the name of Java the Less. It began to be known to foreigners as Sumatra in the last half of the 14th century. Before the middle of the 15th century it was reached by the Venetian traveller Nicolò di Conti. The Portuguese first arrived there in 1509, visiting the Acheen coast, where they found a powerful king, who effectually opposed their efforts to obtain a footing. The hostilities thus begun between Portugal and Acheen continued with but little intermission till 1641, when the Portuguese lost Malacca. Sumatra was first visited by the Dutch in 1599 and by the English in 1602. The Dutch formed a settlement at Padang in 1649, got possession of some districts in the S. part of the island, and established several factories. In 1795 all their Sumatran territories fell into the hands of the English, who had established a station at Bencoolen in 1685. They were restored in 1815, but Bencoolen was retained till 1824, when all the British possessions in Sumatra were ceded to the Netherlands in exchange for Malacca and small settlements upon the coasts of India. The Dutch have since found means to annex a great extent of territory. At the time of the treaty of 1824, the Dutch government pledged itself not to assail Acheen, but for many years the prevalence of piracy and the ill treatment of foreign vessels on the N. coast have led to much complaint. All objections on the part of Great Britain to the extension of Dutch rule in Sumatra were removed by a treaty made in 1871, and in consequence of repeated violations of faith on the part of the sultan of Acheen, a naval and military expedition was despatched from the Netherlands to the N. coast of Sumatra in 1873. It was repulsed by the Acheenese with heavy loss, and the war has since been carried on with varying success.

**SUMBAWA,** an island of the Indian archipelago, in the Sunda chain, lying between Flores on the east and Lombok on the west, the S. W. point in lat. 9° 2′ S., lon. 116° 42′ E.; length E. and W. about 170 m., extreme breadth 50 m.; estimated area, 6,000 sq. m.; pop. about 80,000. Wallace classifies it zoölogically in the Timor group. A deep bay penetrates the N. coast, and it is separated from Flores by Sapi and Mangerai straits, between which lies the island of Comodo. Sumbawa is divided into six native states, each governed by a rajah who acknowledges the supremacy of the Dutch. They are Tomboro and Sumbawa on the N. coast, Bima on the E. coast, where the Dutch have a resident, and Dompo, Sangar, and Papakat. The island is mountainous, and lies within the volcanic belt of the Indian archipelago, containing Mt. Tomboro, a volcano near the N. coast, 8,940 ft. high, the eruption of which in 1815 caused a subsidence of the surface, and was characterized by tremendous explosions which were heard over an area having a radius of more than 800 m. Nearly 12,000 persons were killed; the ashes fell in Java and Flores to the depth of several inches, and even in Sumatra, 840 m. from the volcano. In Lombok immense damage was done and many lives were lost. In 1836 a less destructive eruption occurred. Gold, sulphur, and saltpetre are found. Sumbawa is not well wooded, but sandal and sapan wood and teak occur to a limited extent. Its horses, among the best in the archipelago, are largely exported. The pearl oyster is found. The manners and language of the natives strongly resemble those of the inhabitants of Celebes. The island has been subject to the Dutch since 1676.

**SUMBUL.** See p. 900.

**SUMMER,** the warm season of the year, including astronomically the time between the vernal and autumnal equinoxes, or from about the 21st of June till about the 22d of September. The calendar summer comprises in the United States the months of June, July, and August; in England, May, June, and July. In the southern hemisphere the summer months are December, January, and February according to the American method of regarding the seasons, or November, December, and January according to the English method. Between the tropics there is no summer properly so called, the hottest times being those when the sun passes to the zenith at noon, which at the equator will correspond to the vernal and autumnal equinoxes, the two dates being on our summer side of the equinoxes for places N. of the equator, and on our winter side in places S. of the equator.—The Indian summer is a period of warm, pleasant weather, which usually occurs every year over the northern portion of the United States after the autumnal storms, and continues often without interruption two or three weeks. It appears to be a more decided season in the interior than near the coast, and in the region of the great lakes is especially noticeable, the waters during its continuance remaining placid, and the atmosphere filled with a peculiar haziness. The Indians regarded it as the gift of their most honored deity, the god of the southwest, who sends the S. W. winds, and to whom they believed their souls to go after their decease.

**SUMMERFIELD, John,** an American clergyman, born in Preston, England, Jan. 31, 1798, died in New York, June 13, 1825. He was educated at a Moravian school, removed to Dublin in 1813, joined the Wesleyan society at the age of 19, and became a preacher. In 1821 he removed to New York, where his eloquence drew crowds to hear him. In 1822 he visited Philadelphia, Baltimore, and Wash-

ington, and in December went to Paris, and then to England. In 1824 he returned to New York, and continued for a time to travel and preach. He was a founder of the American tract society. His biography has been written by John Holland (8vo, New York, 1829), and by William M. Willett (Philadelphia, 1857). His "Sermons and Sketches of Sermons" were published at New York in 1842.

**SUMMER RED BIRD.** See TANAGER.

**SUMMERS,** a central county of West Virginia, bounded S. W. by the Meadow river, and intersected by Gauley river. It has been formed since the census of 1870 from Nicholas co. The surface is greatly diversified, and the valleys are productive. The staples are wheat, corn, oats, hay, and dairy products. Capital, Hinton.

**SUMMERS, Thomas Osmond,** an American clergyman, born near Corfe Castle, Dorsetshire, England, Oct. 11, 1812. He emigrated to the United States in 1830, and became a preacher of the Methodist Episcopal church, at first in Virginia. In 1840 he went to Texas as one of nine ministers to constitute the first conference there. In 1844 he joined the Alabama conference, and as secretary of the convention at Louisville, Ky., assisted in organizing the Methodist Episcopal church, South. By appointment, he assisted in editing the "Southern Christian Advocate" and in compiling a new hymn book. In 1850 the general conference elected him editor of their books and tracts, and of the "Sunday School Visitor," and in 1858 also of the "Quarterly Review." In 1866 he was elected editor of the "Nashville Christian Advocate," and in 1874 professor of systematic theology in the new Vanderbilt university, Nashville, Tenn. His writings include "Commentaries on the Gospels and on the Acts of the Apostles;" "Commentary on the Ritual of the M. E. Church, South;" "A Treatise on Baptism;" "A Treatise on Holiness;" "Sunday School Teacher, or the Catechetical Office;" "Seasons, Months, and Days;" "Talks Pleasant and Profitable;" "The Golden Censer;" "Scripture Catechism" (2 vols., Old and New Testament); "Refutation of Thomas Paine's Theological Writings;" and an enlargement and revision of Watson's "Biblical and Theological Dictionary."

**SUMMIT. I.** A N. E. county of Ohio, drained by the Cuyahoga river and the head streams of the Tuscarawas, and traversed by the Ohio canal and several railroads; area, 400 sq. m.; pop. in 1870, 34,674. It is the most elevated land on the line of the Ohio canal. The surface is uneven and the soil highly fertile. Coal is mined in large quantities. Water power abounds. The chief productions in 1873 were 307,123 bushels of wheat, 633,619 of Indian corn, 386,714 of oats, 98,489 of potatoes, 32,587 tons of hay, 105,639 lbs. of wool, 749,370 of butter, and 1,586,842 of cheese. In 1874 there were 8,223 horses, 23,911 cattle, 28,065 sheep, and 9,594 hogs. In 1870 there were 5 manufactories of agricultural implements, 10 of brick, 23 of carriages and wagons, 11 of cheese, 16 of cooperage, 1 of cutlery and edge tools, 1 of anchors and chains, 8 of iron castings, 9 of tanned and 6 of curried leather, 7 of machinery, 3 of paper, 26 of stone and earthen ware, 3 of woollen goods, 10 flour mills, and 15 saw mills. Capital, Akron. **II.** A N. W. county of Colorado, bordering on Utah, and watered by the Grand, White, and Bear rivers; area, about 8,500 sq. m.; pop. in 1870, 258. This county formerly occupied the whole N. W. corner of the territory W. of the Rocky mountains, but in 1874 Grand co., with an area of about 11,000 sq. m., was formed from the N. portion. The E. includes a portion of the Middle park, and is crossed by the Rocky mountains. The W. portion is densely timbered with pine and spruce, and there are immense beds of coal. Gold, copper, lead, iron, and zinc are found. On the Grand and Blue rivers and their tributaries are good grazing lands; little is known of the agricultural capabilities of the county. The population is chiefly in the S. E. corner, on the head waters of the Blue river, and is almost exclusively engaged in gold placer mining. Capital, Breckinridge. **III.** A N. E. county of Utah, bordering on Wyoming, and containing the head waters of Bear and Weber rivers; area, 1,250 sq. m.; pop. in 1870, 2,512. It is crossed by the Union Pacific railroad. The surface is mountainous. Coal, gold, silver, and lead are found. The chief productions in 1870 were 18,955 bushels of wheat, 2,028 of oats, 1,352 of barley, 12,149 of potatoes, 13,540 lbs. of butter, and 2,569 tons of hay. The value of live stock was $65,353. Capital, Coalville.

**SUMNER. I.** A N. central county of Mississippi, formed in 1874 from Choctaw, Montgomery, and Oktibbeha counties; area, 408 sq. m.; pop. about 8,000. It is drained by the Big Black river. The surface is somewhat undulating and the soil productive. The chief crops are Indian corn, sweet potatoes, and cotton. Capital, Mt. Tabor. **II.** A N. county of Tennessee, bordering on Kentucky, bounded S. by the Cumberland river and drained by affluents of Big Barren river; area, about 500 sq. m.; pop. in 1870, 23,711, of whom 7,777 were colored. The surface is undulating and the soil fertile. The Louisville, Nashville, and Great Southern railroad passes through it. The chief productions in 1870 were 163,114 bushels of wheat, 1,155,914 of Indian corn, 233,837 of oats, 35,253 of Irish and 25,074 of sweet potatoes, 4,921 tons of hay, 909,568 lbs. of tobacco, 38,860 of wool, 224,295 of butter, 15,668 of honey, and 38,563 gallons of sorghum molasses. There were 7,582 horses, 3,078 mules and asses, 5,378 milch cows, 9,500 other cattle, 20,421 sheep, and 37,304 swine. Capital, Gallatin. **III.** A S. county of Kansas, bordering on Indian territory, and intersected in the northeast by the Arkansas river; area, 1,152 sq. m.; pop. in 1870, 22; in 1875, 4,925. It consists of fertile prairies. Capital, Sumner.

**SUMNER, Charles,** an American statesman, born in Boston, Mass., Jan. 6, 1811, died in Washington, D. C., March 11, 1874. His father, who died in 1839, was a graduate of Harvard college, a lawyer, and for 14 years high sheriff of the county of Suffolk. The son received his early education at the Boston Latin school, and graduated at Harvard college in 1830. He was appointed reporter of the circuit court of the United States, in which capacity he published three volumes known as "Sumner's Reports," containing decisions of Judge Story. He also at the same time edited the "American Jurist," a quarterly law journal of high reputation. During the first three winters after his admission to the bar, while Judge Story was absent in Washington, Mr. Sumner was appointed lecturer to the law students, and part of the time he had sole charge of the school. His favorite topics were those relating to constitutional law and the law of nations. He visited Europe in 1837, travelled in Italy, Germany, and France, and resided for nearly a year in England. He carried to England a letter of introduction from Judge Story, in which he was described as "a young lawyer giving promise of the most eminent distinction in his profession, with truly extraordinary attainments, literary and judicial; and a gentleman of the highest purity and propriety of character." He was received with unusual distinction in the highest circles, was introduced by eminent statesmen on the floor of the houses of parliament, and invited by the chief judges to sit with them in Westminster hall. He returned to Boston in 1840, and in 1844-'6 published an elaborate edition with annotations of "Vesey's Reports" in 20 vols. Though voting with the whig party, he took no active part in politics till 1845, when on the 4th of July he pronounced before the municipal authorities of Boston an oration on "The True Grandeur of Nations," in which, prompted by the menacing aspect of affairs between the United States and Mexico, he denounced the war system as the ordeal by battle still unwisely continued by international law as the arbiter of justice between nations, and insisted that this system ought to give way to peaceful arbitration for the adjudication of international questions. His oration attracted unusual attention, led to much controversy, and was widely circulated both in America and Europe. It was followed by a rapid succession of public addresses on kindred themes, which were also widely circulated. Mr. Sumner earnestly engaged in the opposition to the annexation of Texas on the ground of slavery. In 1846 he made an address to the whig state convention of Massachusetts on "The Anti-Slavery Duties of the Whig Party," and shortly afterward published a letter of rebuke to Mr. Robert C. Winthrop, who then represented Boston in congress, for his vote in favor of the war with Mexico. These steps led eventually to Mr. Sumner's separation from the whig party and association with the freesoilers, to whose candidates, Van Buren and Adams, he lent efficient support in the presidential contest of 1848. After the withdrawal of Mr. Webster from the senate of the United States by his entrance into the cabinet of Mr. Fillmore in 1850, Mr. Sumner was nominated for the vacancy by a coalition of freesoilers and democrats in the Massachusetts legislature, and was elected on April 24, 1851, after a most earnest and protracted contest. He took his seat on Dec. 1, 1851, and retained it by successive reëlections till his death. His first important speech was upon the fugitive slave act, against which he argued that congress had no power under the constitution to legislate for the rendition of fugitive slaves; and that if it had, the act in many essential particulars conflicted with the constitution, and was also cruel and tyrannical. In this speech Mr. Sumner laid down as a guide for political action the formula to which he ever afterward adhered, that "freedom is national and slavery sectional." In the debate on the repeal of the Missouri compromise and on the contest in Kansas, Mr. Sumner took a very prominent part. His last speech upon this topic, which was printed under the title of "The Crime against Kansas," occupied two days in its delivery, May 19 and 20, 1856. Some passages in it greatly incensed the members of congress from South Carolina, one of whom, Preston S. Brooks, on May 22 assaulted Mr. Sumner while he was writing at his desk in the senate chamber, and with a gutta percha cane struck him on the head till he fell to the floor insensible. (See Brooks, Preston S.) The injury thus received proved very serious, and was followed by a severe and long disability, from which his recovery was not complete till three or four years later. His term of office as senator expired March 4, 1857, and in the preceding January the legislature of Massachusetts reëlected him by a unanimous vote in the senate, while in the house of representatives, consisting of several hundred members, he received all but seven votes. Under the advice of physicians he went to Europe for the benefit of his health in March, 1857, and returned in the autumn to resume his seat in the senate. His health being still impaired, he went abroad again in May, 1858, remaining till the autumn of 1859, and submitted to a course of extraordinarily severe medical treatment in Paris. His next serious effort was an elaborate speech in the senate, denouncing the influence of slavery on character, society, and civilization, which was printed under the title of "The Barbarism of Slavery." In the presidential contest of 1860 he made several speeches in behalf of Abraham Lincoln and Hannibal Hamlin. In the senate and in popular addresses during the civil war he earnestly opposed all concession to or compromise with slavery, and early proposed emancipation as the speedi-

est mode of bringing the war to a close. He based his arguments not only on moral and historical, but on constitutional grounds, and always claimed that his positions were in strict accordance with the constitution of the United States. In March, 1861, when the republican party obtained the control of the senate, Mr. Sumner was made chairman of the committee on foreign relations. On Jan. 9, 1862, he delivered an elaborate speech arguing that the seizure of Messrs. Mason and Slidell on board the steamer Trent was unjustifiable on the principles of international law which had always been maintained by the United States. This speech had great influence in reconciling the public to the surrender of the confederate envoys. Later in the war he made powerful speeches on "Our Foreign Relations" (1863), and on "The Case of the Florida" (1864), and in 1865 he pronounced a eulogy on President Lincoln. A speech upon our claims on England, April 13, 1869, caused great excitement and indignation in Great Britain, where it was erroneously supposed to threaten war and regarded as an attempt to excite popular feeling against that country by exaggerating the "consequential damages" she had incurred in recognizing the belligerency of the seceding states and in allowing the confederate cruisers to sail from her ports. In the same year his opposition to the Santo Domingo treaty, against which he delivered a speech in the senate, brought him into collision with the administration of President Grant, and led to his removal in March, 1870, from the chairmanship of the committee on foreign relations, and ultimately to his separation from the republican party and his support of Horace Greeley, the liberal republican and democratic candidate for president in 1872. In the spring of that year he had delivered in the senate an animated speech against the renomination of President Grant, which did not have the weight he expected with the republican convention that met shortly afterward. On Sept. 11 a convention of democrats and liberal republicans, held at Worcester, Mass., nominated him for governor of the state; but he had already gone to Europe for medical advice, and when the news of his nomination reached him in England he declined it. He returned from Europe late in 1872, and on taking his seat in the senate reintroduced two measures which he had unsuccessfully proposed before. One was the civil rights bill, the other a resolution providing that the names of the battles won over fellow citizens in the civil war should be removed from the regimental colors of the army and from the army register. This last resolution was strongly denounced, and led to a vote of censure on him by the legislature of Massachusetts in 1873, which was rescinded in 1874, shortly before his death. He died of angina pectoris, after an illness of a few hours. Mr. Sumner's addresses were first collected under the title of "Orations and Speeches" (2 vols. 12mo, Boston, 1850), to which was added "Recent Speeches and Addresses" (12mo, Boston, 1856). During the last years of his life he prepared a final and complete collection entitled "The Works of Charles Sumner" (12 vols., Boston, 1871-'5). Two or three more volumes are to appear, under the charge of his executors, of whom the chief is Prof. Longfellow.—See "A Memorial of Charles Sumner," published by order of the legislature of Massachusetts (Boston, 1874), and "Life and Public Services of Charles Sumner," by C. Edwards Lester (New York, 1874).

**SUMNER, John Bird,** an English clergyman, born at Kenilworth, Warwickshire, in 1780, died in London, Sept. 6, 1862. He graduated at Cambridge, and in 1820 became canon of Durham, in 1828 bishop of Chester, and in 1848 archbishop of Canterbury. He was a leader of the evangelical school in the church of England, and while he was primate of England occurred the controversy about the work entitled "Essays and Reviews," and also the revival of the synodical power of the convocations. He published an essay on "Apostolical Preaching" (London, 1815); "The Records of Creation" (2 vols., 1816), which won the second Burnet prize of £400; "Evidences of Christianity" (1824); and a volume of selections entitled "Practical Reflections" (1859).

**SUMTER,** the name of four counties in the United States. **I.** An E. county of South Carolina, bounded W. by the Wateree river, and drained by Black river and its affluents; area, about 900 sq. m.; pop. in 1875, 31,480, of whom 23,086 were colored. The surface is generally undulating and the soil fertile, and there are extensive forests of pine. It is intersected by the Wilmington, Columbia, and Augusta railroad and its branch. The chief productions in 1870 were 189,039 bushels of Indian corn, 36,113 of sweet potatoes, 7,212 bales of cotton, 245,325 lbs. of rice, and 2,282 tons of hay. There were 905 horses, 1,126 mules and asses, 1,699 milch cows, 2,630 other cattle, 1,075 sheep, and 658 swine; 6 manufactories of carriages and wagons, 4 of tar and turpentine, and 5 saw mills. Capital, Sumter Court House. **II.** A S. W. county of Georgia, bounded E. by Flint river; area, about 600 sq. m.; pop. in 1870, 16,559, of whom 10,639 were colored. The surface is level and the soil fertile. It is traversed by the Southwestern railroad. The chief productions in 1870 were 280,379 bushels of Indian corn, 22,085 of oats, 11,516 of peas and beans, 40,924 of sweet potatoes, 12,823 bales of cotton, 61,031 lbs. of butter, and 15,310 gallons of molasses. There were 634 horses, 1,796 mules and asses, 1,768 milch cows, 3,878 other cattle, 832 sheep, and 12,624 swine. Capital, Americus. **III.** A central county of Florida, bounded W. by the Withlacoochee river; area, 1,370 sq. m.; pop. in 1870, 2,952, of whom 980 were colored. The surface is generally level and swampy, and there are several small lakes.

The chief productions in 1870 were 67,278 bushels of Indian corn, 112,620 of sweet potatoes, 8,800 lbs. of rice, 501 bales of cotton, and 13,650 gallons of molasses. There were 14,995 cattle and 5,480 swine. Capital, Leesburg. **IV.** A W. county of Alabama, bordering on Mississippi, bounded E. by the Tombigbee and intersected by the Noxubee river; area, about 800 sq. m.; pop. in 1870, 24,109, of whom 18,907 were colored. The surface is uneven and the soil fertile. It has water communication by the Tombigbee river, and is intersected by the Alabama and Chattanooga railroad and a branch of the Mobile and Ohio. The chief productions in 1870 were 334,110 bushels of wheat, 14,941 of sweet potatoes, 2,513 lbs. of wool, and 11,646 bales of cotton. There were 1,242 horses, 1,957 mules and asses, 2,097 milch cows, 988 working oxen, 3,644 other cattle, 2,249 sheep, and 8,024 swine. Capital, Livingston.

**SUMTER, Fort,** a work built upon an artificial island near the entrance of the harbor of Charleston, S. C., which it was designed to protect. It stands about 2¾ m. from Castle Pinckney, the fort near the point of the peninsula upon which Charleston is built, and about half that distance from Fort Moultrie on Sullivan's island. It was intended to mount 140 heavy guns, in three tiers; but at the close of 1860 the fort was still incomplete, few of the guns being mounted. The United States garrison, numbering 109 men, of whom only 63 were combatants, under Major Robert Anderson, occupied Fort Moultrie. On the night of Dec. 26 Major Anderson, learning that the secessionists had made preparations to capture Fort Moultrie and seize the other fortifications near Charleston, transferred his force to Fort Sumter. Here he was able to mount only 52 of the lighter guns. About the same time commissioners were sent by the state authorities to demand from the government of the United States the surrender of all the forts in South Carolina. President Buchanan refused, and Fort Sumter was virtually in a state of siege. Early in January, 1861, an unsuccessful attempt was made to throw in supplies, by means of an expedition from New York in the steamer Star of the West. On April 11 Gen. Beauregard, who had been placed in command of the forces raised by the confederate government, and had constructed powerful batteries on every point commanding Fort Sumter, demanded the immediate surrender of the fort. Major Anderson refused, but said that if he was not reënforced by the 15th he would evacuate the fort; to which Beauregard responded that he would open fire at about half past 4 on the morning of April 12. Fire was accordingly opened, and in a few hours the works were seriously damaged. The bombardment was fiercely continued, but no one was hurt. The provisions and ammunition being nearly exhausted, the evacuation of the fort was agreed upon on the afternoon of the 13th, and on the 14th Major Anderson marched out with flying colors. The confederates strengthened the fort and put in a strong garrison, and until near the close of the war it formed the main defence of Charleston. In April, 1863, it was unsuccessfully bombarded by a monitor fleet under Admiral Du Pont. Still later it was subjected to a heavy fire from batteries erected on Morris island, and reduced almost to a mass of shapeless ruins; but every direct attempt to take it failed, and it fell into Union hands only when Charleston was finally abandoned by the confederates in February, 1865. (See CHARLESTON.) On April 14, 1865, just four years after the surrender, the Union flag, the same which had been lowered in 1861, was again formally raised over the dilapidated walls of Fort Sumter.

**SUMTER, Thomas,** an American revolutionary general, born in Virginia in 1734, died near Camden, S. C., June 1, 1832. He was a volunteer in the French and Indian war, was present at Braddock's defeat, and in March, 1776, became lieutenant colonel of the second regiment of South Carolina riflemen. After the capture of Charleston by the British in 1780, he took refuge in the swamps of the Santee, and, with the rank of brigadier general, became one of the most active and able partisan leaders of the south. On July 12 he defeated a British detachment on the Catawba, but on Aug. 18 was surprised and routed at Fishing creek by Tarleton. He collected another corps, and on Nov. 12 defeated Col. Wemyss, who had attacked his camp in Chester district near Broad river. A few days later Tarleton attempted to surprise him while encamped at Blackstocks on the Tiger river, but was compelled to retreat with severe loss. Sumter was severely wounded in this encounter; but in March, 1781, he raised three new regiments, and, in concert with Marion, Pickens, and others, harassed the enemy's scattered posts in the low country. In January, 1781, congress passed a resolution of thanks to him and his men. He was a member of congress from South Carolina in 1789–'93, and United States senator in 1801–'9; and in 1809 he was appointed minister to Brazil, where he remained two years. He was the last surviving general of the revolution.

**SUN,** the central ruling body of the planetary system, and the great source of light and heat. The visible orb of the sun, as distinguished from the complex structure of which that orb is but a part, is a globe about 853,000 m. in diameter. So far as observation extends, this globe is spherical in shape, no difference having been detected in the polar and equatorial diameters. In fact, no single set of measurements, however carefully made, could lead to the conclusion that there is any compression in the solar orb, since the equality of the diameters results not from a single set of measures, but from comparisons between many thousands of observations made at Greenwich, Paris, Washington, and other leading observa-

tories. The volume of the sun exceeds the earth's nearly 1,253,000 times. His mean density is almost exactly equal to one fourth of the earth's, so that his mass exceeds hers about 316,000 times. Gravity at the visible boundary of the solar globe exceeds gravity at the earth's surface about 27·1 times; and a body dropped from rest near the sun's surface would fall through 436 ft. in the first second, and have acquired a velocity of 872 ft. a second, or about 10 m. a minute. The sun's mass exceeds the combined mass of all the planets about 750 times. His mean distance from the earth has been estimated at about 91,430,000 m.; though we may expect that the results obtained during the late transit of Venus (December, 1874) and to be obtained during the coming transit (December, 1882) will lead to some correction of this estimate. It already appears probable that the sun's estimated mean distance must be increased to about 92,000,000 m. The greatest and least distances of the sun from the earth (assuming his mean distance to be 91,430,000 m.) are respectively 92,963,000 and 89,897,000 m.; and his apparent diameter varies from 31′ 31·8″ to 32′ 36·4″ as he passes from his greatest to his least distance.—The sun has an apparent motion among the stars from west to east along the great circle called the ecliptic (see ECLIPTIC), making a complete circuit of the heavens in 365 days, 6 hours, 9 minutes, and 9·6 seconds, though the passage from vernal equinox to vernal equinox (first point of Aries) occupies only 365d. 5h. 48m. 48·6s., because of the precession of the equinoxes. (See PRECESSION.) These two periods are called respectively the sidereal year and the tropical year. There is one other astronomical year (besides the civil, Julian, and lunar years) known as the anomalistic year, being the interval separating successive passages of the perigee of the solar path, viewed geometrically; its length amounts to 365d. 6h. 13m. 49·3s. The apparent motion of the sun is not uniform in the ecliptic, owing to the eccentricity of the earth's orbit; it is greatest about Dec. 31 to Jan. 1, when he moves through 1° 1′ 9·9″ in 24h., and least about June 30–July 1, when he only moves through 0° 57′ 11·5″ in 24h. The sun has also three real motions: 1, an axial rotation, the nature of which will presently be described; 2, a motion about the centre of gravity of the whole solar system, but in consequence of the great superiority of his mass over that of all the other bodies this centre of inertia is always within the sun's volume; 3, a progressive motion in space toward the direction of the constellation Hercules, the rate of which has been estimated at 150,000,000 m. per annum, but on evidence exceedingly questionable. The fact of solar motion toward Hercules is as nearly certain as possible, but the rate of this motion is not known. Recent researches suggest that it is far greater than the rate just mentioned, great though that rate may appear.—Examined with a telescope, the sun's surface, which appears very nearly uniform to the naked eye, is seen to be brightest near the centre, and to grow progressively darker toward the circumference. It is also marked by various irregularities, spots, faculæ, mottling, besides other appearances requiring greater telescopic power for their detection. The spots on the sun were independently discovered by Galileo, Fabricius, Scheiner, and Harriot. It was soon perceived that they move in such a way as to indicate that they are real surface markings, not bodies passing between the earth and the sun, and that therefore the sun's rotation can be measured by observing them. It was found that the sun rotates in a period of about 25⅓ days; and as the spots do not at all times pass on straight lines across the sun's face, but sometimes on a course slightly bowed upward and at others on a course slightly bowed downward, it was seen that the sun's axis of rotation is not quite upright as referred to the plane of the ecliptic, but slightly inclined. The following elements of the sun's rotation belong to the astronomy of recent times, having been deduced from results obtained by Carrington and Spörer, reduced to the year 1869:

| ELEMENTS. | Carrington. | Spörer. |
|---|---|---|
| Longitude of node of solar equator.... | 73° 57′ | 74° 87′ |
| Inclination of solar equator........... | 7 15 | 6 57 |
| Mean diurnal rotation.................. | 14 18 | 14 27 |
| Mean rotation period................... | 25·38d. | 25·234d. |

It will be perceived that a mean rotation is indicated. Carrington's observations have shown that spots in different solar latitudes travel at different rates, varying in fact from a daily rotation through about $12\frac{2}{3}°$ in lat. 50° (nearly the highest in which spots have been observed) to a daily rotation through nearly $14\frac{1}{2}°$ at the solar equator (where, however, spots are very rarely seen). Carrington gives the following formula for the rotation in different solar latitudes: daily rotation $= 14° 25' - (2° 45') \sin.^{\frac{7}{4}}$ lat.; but this formula is purely empirical. The curious point about this variation in the rate of turning is that, taking two parts of the visible solar surface in the same longitude, but one in lat. 45° (say), the other on the equator, the latter will advance further and further in longitude from the former, gaining daily about two degrees, so that in the course of about 180 days it will have gained a complete revolution. That is to say, the sun's equator makes about two revolutions more per annum than the regions in 45° north and south solar latitude. The spots on the sun have usually a dark central region called the *umbra*, within which is a still darker part, called the *nucleus*, while around this there is a fringe of fainter shade than the umbra, called the *penumbra*. Although the umbra and nucleus appear dark, however, it is not to be supposed that they are really dark; in fact, Prof. Langley of Pittsburgh has succeeded in examining the light from the nucleus alone,

and he finds that though the nucleus looks perfectly black by contrast with the general surface, it shines in reality with a light unbearably brilliant when viewed alone, while his thermal measurements show that the heat from the nucleus is even greater proportionately than the light, and not very greatly below the heat of the surrounding surface. The boundary between the umbra and the penumbra is in general well defined; and commonly the inner part of the penumbra nearest to the umbra is brighter than the exterior portion. Many spots are of enormous size, so as to be visible with the naked eye. Sir W. Herschel saw one in 1779 which had a diameter exceeding 50,000 m., and many far larger than this have since been seen. The spots are not scattered over the whole surface of the sun, but are for the most part confined to two belts between lat. 5° and 30° on either side of the solar equator. An equatorial zone 6° wide is almost entirely free from spots. Owing to this peculiarity of arrangement, Sir J. Herschel suggested the existence of motions in the solar atmosphere corresponding to our trade winds; but the circumstances of the solar orb and atmosphere differ so entirely from those of our earth and air, that such comparisons are unsafe. Dr. Wilson of Glasgow was the first to show that the umbra of a spot is below the level of the penumbra. He observed that a spot, visible in 1769, changed in shape as it traversed the solar disk, precisely as it would if the spot had been a depression below the general surface of the sun. The penumbra was markedly wider on the side nearest the edge of the solar disk than on the other side, whereas the reverse should have been the case if the spot had been a surface marking. Sir W. Herschel in 1777 began a series of solar observations which before long confirmed Wilson's views. He was led to explain the spots by the theory that the sun's globe is surrounded by two layers of clouds, suspended in an atmosphere at different elevations. He supposed the upper cloud stratum to be self-luminous, and to be the source of the solar light, or the true photosphere (to use a convenient term invented by Schröter). The lower layer he regarded as opaque, and as owing whatever light it appears to possess to the reflection of light received from the upper layer. He supposed that when an opening is formed in the outer layer we see merely a penumbral spot; but that when the inner layer also is displaced we see the true surface of the sun, which he supposed to be solid, and not necessarily so heated as to be unfit for habitation. Modern researches show this part at least of Herschel's theory to be wholly untenable, everything tending to prove that the whole mass of the sun to its innermost core is intensely heated. The recognition of a nucleus within the umbra would seem to indicate that a third cloud layer exists within the second or internal layer of Herschel's theory. But the observations of Prof. Langley show that most probably all the features of the solar photosphere yet observed are phenomena of cloud envelopes, since he has been able to recognize cloud forms at one level floating over cloud forms at a lower level, while even in the (relatively) darkest depths of the nucleus clouds are still to be perceived, though so deep down that their outlines can be barely discerned. The study of the solar spectrum (see SPECTRUM ANALYSIS), while revealing much respecting the constitution and physical condition of the solar orb, has thrown some light also on the nature of sun spots. Mr. Huggins, for instance, has found that several of the absorption bands belonging to the solar spectrum are wider in the spectrum of a spot, a circumstance indicative of increased absorption so far as the vapors corresponding to such lines are concerned. Spots are more numerous in some years than in others, and occasionally no spots are visible for many successive days. Schwabe of Dessau began to study this peculiarity in 1826, and after many years recognized a remarkable periodicity in the frequency of sun spots. They are found gradually to increase in number during a certain period, and then to decrease until at length there are no spots; then they increase again, and so on. According to Schwabe's earlier investigations, the cycle lasts 10⅓ years; but Wolf of Zürich has found by examining earlier observations that the true average period is about 11·11 years. (See MAGNETISM, TERRESTRIAL.) Various minor cycles have been suspected, besides a long cycle of about 56 years. Wolf in 1859 presented a formula by which the frequency of spots is connected with the motions of the four bodies, Venus, the earth, Jupiter, and Saturn. Prof. Loomis of Yale college has since advocated a theory (suggested by the present writer in 1865, in "Saturn and its System," p. 168, note) that the long cycle of 56 years is related to the successive conjunctions of Saturn and Jupiter. But the association is as yet very far from being demonstrated, to say the least.—Besides the spots, the telescope reveals minute dark dots or pores mottling the surface, which have been lately found to be the intervals separating numberless cloud-like forms, apparently minute, but in reality from 200 to 1,000 m. in diameter, the brilliancy of which so greatly exceeds that of the intervening spaces that they must be recognized as the principal radiators of the solar light and heat. These are found to be in constant fluctuation, and Sir J. Herschel compares their appearance to the slow subsidence of some flocculent chemical precipitates in a transparent fluid when viewed perpendicularly from above. Near the great spots or groups of spots there are often seen streaks more luminous than the neighboring surface, called *faculæ*. They are oftenest seen toward the borders of the disk. Mr. Dawes saw, on Oct. 22, 1859, in a large mass of faculæ, one bright streak forming the

very edge of the sun, and projecting irregularly beyond the circular contour, reminding him of a ridge of low hills often seen at the enlightened limb of the moon. M. Chacornac, a most diligent French investigator, observed on one occasion a sudden transformation of the luminous part of the photosphere into dark parts; luminous bridges were seen crossing the spots, and then gradually becoming dark. As these luminous bridges darkened, they at the same time plunged into the deeper parts, and became covered with other luminous bridges which formed above them.—The phenomena witnessed during total solar eclipses are next to be considered. The red prominences were first seen during the solar eclipse of July 8, 1842. In the eclipse of July 28, 1851, it was shown that they belong to the sun, since the advancing moon visibly concealed those on one side and disclosed those on the other side. During the eclipse of June 18, 1860, Secchi and De la Rue photographed the prominences at two stations in Spain, and thenceforth the solar nature of these appendages was admitted by all. As some of them were seen to extend fully 3′ from the edge of the sun on that occasion, it became manifest that they are objects of enormous dimensions, since 3′ at the sun's distance corresponds to an extension of about 80,000 m. In the Indian eclipse of August, 1868, the prominences were examined with the spectroscope by Col. Tennant, Capt. Herschel, and Messrs. Janssen and Rayet. The spectrum was found to consist of bright lines, showing that the colored prominences are masses of glowing gas, the bright lines of hydrogen were recognized, and an orange-yellow line was ascribed (mistakenly, however) to sodium. But on the following day Janssen applied a new method of research, the principle of which had been indicated earlier by Huggins ("Report of Council of Astronomical Society," "Monthly Notices," February, 1868). Since prismatic dispersion reduces the brightness of the solar spectrum, but only throws the lines of a gaseous spectrum further apart, it follows that by directing a tele-spectroscope toward the place of a prominence, the light from the air which usually obliterates the prominence light can be so reduced by sufficient dispersion that the prominence lines may be rendered visible. Janssen found this to be the case, and by noting the indications thus afforded he was able to determine the presence and even the shape of prominences at various parts of the sun's edge. Two months later, but before the news of Janssen's success had reached England, Mr. Lockyer obtained a similar result. Before long Huggins, who had been the first to enunciate the principle of the method, showed how by opening the slit of the spectroscope the whole of a prominence could be seen at once. Since then the prominences have been successfully studied by Zöllner, Respighi, Secchi, and others. Prof. Young of Dartmouth college has been particularly successful in applying this method of research.—Even before the prominences were discovered, it was known that a border of red light surrounds the solar disk; it had been seen on the eastern side at the beginning of total eclipse, and on the western side at the end. In 1860 this envelope was very clearly seen, and even photographed. It has been designated as the sierra, because of its serrated appearance; but recently the name chromosphere (for chromatosphere) has been given to it. The observations of prominences and sierra as summarized by Secchi indicate the following results: "The sierra presents four aspects: 1, smooth, with defined outline; 2, smooth, but no defined outline; 3, fringed with filaments; and 4, irregularly fringed with small flames. The prominences may be divided into three orders, heaps, jets, and plumes. The heaped prominences need no special description. The jets are those to which alone the following description by Respighi (erroneously given as generally applicable to all prominences) can be applied: 'They originate generally in rectilinear jets either vertical or oblique, very bright and very well defined. They rise to a great height, often to a height of at least 80,000 m., and occasionally to more than twice that; then bending back, fall again upon the sun like the jets of our fountains. Then they spread into figures resembling gigantic trees more or less rich in branches.' Their luminosity," proceeds Secchi, "is intense, insomuch that they can be seen through the light clouds into which the sierra breaks up. Their spectrum indicates the presence of many elements besides hydrogen. When they have reached a certain height they cease to grow, and become transformed into exceedingly bright masses, which eventually separate into fleecy clouds. The jet prominences last but a short time, rarely an hour, frequently but a few minutes, and they are only to be seen in the neighborhood of the spots. Wherever there are jet prominences there also are faculæ. The plume prominences are distinguished from the jets in not being characterized by any signs of an eruptive origin. They often extend to an enormous height; they last longer than the jets, though subject to rapid changes of figure; and lastly they are distributed indifferently over the sun's surface. It would seem that in jets a part of the photosphere is lifted up, whereas in the case of plumes only the sierra is disturbed." (It is here of importance to remark that these eruptive prominences, particularly associated with spots, are of late becoming recognized as chiefly due to metallic vapors, in distinction from the "plume" forms, which are largely composed of hydrogen.) This account would be incomplete without a description of the remarkable solar explosion actually witnessed by Prof. Young on Sept. 7, 1871. Fig. 1 represents a cloud prominence he had been observing on the eastern limb of the sun. It was about 100,000 m. long by 54,000 m. high. He was called

away at 12h. 30m., and on returning at 12h. 55m. "found that the whole thing had been lit-

Fig. 1.—Prominence as it appeared at half-past 12 o'clock, Sept. 7, 1871.

erally blown to shreds by some inconceivable up-rush from beneath." Fig. 2 represents the appearance when the up-rushing hydrogen had attained its greatest height, exceeding 200,000 m. "The whole phenomenon," he says, "suggested most forcibly the idea of an explosion under the great prominence, acting mainly upward, but also in all directions outward, and then after an interval followed by a corresponding in-rush." A strange circumstance remains to be mentioned: "The same afternoon a portion of the sierra on the

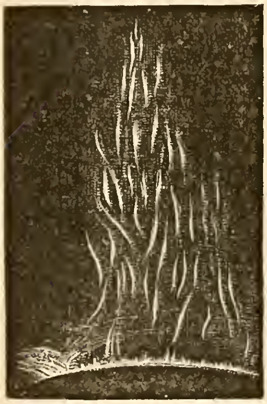


Fig. 2.—As the above appeared half an hour later.

opposite limb of the sun was for several hours in a state of unusual brilliance and excitement, and showed in the spectroscope more than 120 bright lines whose position was determined and catalogued—all that I had ever seen before and some 15 or 20 besides." Before passing from the prominences it may be well to indicate the laws of their numerical distribution, as determined by Secchi and others. This is shown in fig. 3. On the left side the results of Carrington's observation of 1,414 spots between 1853 and 1861 are indicated, and on the right the result of Secchi's observations of 2,767 protuberances in 1871, the number of spots or prominences being of course shown by the length of the radial lines. The dotted line on the right-hand side represents in the same manner the distribution of the larger prominences, viz., those exceeding 1′ or 27,000 m. in height.—During a total eclipse there appears around the black body of the moon a halo or glory of light, bright, close to the place of the concealed sun, but gradually fading away outward, until its light is lost in the general tint of the sky. In this glory of light, which is called the solar *corona*, radiations are also sometimes seen, and under favorable atmospheric conditions complicated series of streaks can be seen extending to a considerable distance outward from the prominence region. Various theories were advanced in former times to explain the corona. According to one theory, it is a phenomenon caused by the solar light falling on our own atmosphere; another theory ascribed it to a lunar atmosphere. In the opinion of Leverrier and Foucault (among others), the corona is an example of the interference of light (see Light), the phenomenon being analogous to the colored fringes seen on a screen in a darkened room when a solar beam is admitted through a chink. To this theory Airy raised the objection that if, in order to make the analogy perfect, the eye is placed in the position of the screen, no colored fringes are seen. It is shown that the corona is partly polarized, and hence partly consists of reflected light. It has been further proved that the plane of polarization passes through the sun and the observer. This was regarded by Airy as pointing to the existence of an atmospheric medium capable of reflecting light, and extending from the earth to the moon. But in more recent times astronomers began to perceive that no other theory can be admitted than that which regards the corona as a true solar appendage. (Of course, it must be admitted that a portion of the light around the eclipsed sun comes from our own atmosphere, which must necessarily be illuminated by the true corona

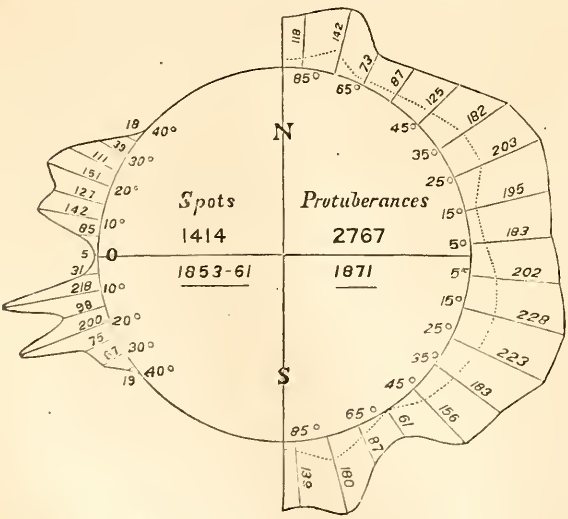



Fig. 3.—Relative Frequency of Protuberances and Sun Spots.

during eclipse, precisely as it is illuminated by the sun when there is no eclipse; but it will readily be understood that this portion of reflected light is very small in amount.) During the solar eclipse of August, 1869, Profs. Young and Harkness discovered that certainly one bright line exists in the spectrum of the corona, and two other lines were suspected. European astronomers expressed doubt as to the accuracy of this observation; but it was confirmed during the Mediterranean eclipse of December, 1870, when Young thus summed up his own and other observations: "There is surrounding the sun, beyond any further reasonable doubt, a mass of self-luminous gaseous matter, whose spectrum is characterized by the green line 1,474 Kirchhoff. The precise extent of this it is hardly possible to consider as determined, but it must be many times the thickness of the red hydrogen portion of the sierra, perhaps on an average 8′ or 10′, with occasional horns of twice that height. It is not at all unlikely that it may even turn out to have no upper limit, but to extend from the sun indefinitely into space." During the same eclipse, Brothers of Manchester and Willard of Philadelphia (the latter acting under the directions of Prof. Winlock of the Harvard observatory) photographed the corona successfully from two distant stations, Willard being near Jerez in Spain, Brothers near Syracuse in Sicily. The views thus obtained agreed so closely (save in circumstances depending on photographic conditions) as to leave no doubt that the corona is a solar phenomenon. Doubts were still expressed, and it was not until the solar eclipse of December, 1871, that these were finally removed. On that occasion the spectroscopic and photographic results were alike decisive. Janssen with the spectroscope not only recognized the bright lines before seen and others less bright, but also a faint solar spectrum, which, since our atmosphere during total eclipse is certainly not illuminated by sunlight, must have been reflected by matter in the solar corona, such as vaporous clouds, meteor flights, or the like. Mr. Davis, a photographer sent out at Lord Lindsay's expense, obtained five excellent photographs of the corona, all agreeing perfectly *inter se*, excepting in extent. This proved certainly that the features of the corona do not change as they would if the phenomenon depended on the passage of light rays athwart lunar inequalities, to fall upon scattered matter at a less distance than the moon. Again Col. Tennant obtained six photographs, similarly accordant *inter se*, and also agreeing perfectly with Mr. Davis's at Dodabetta, a station far removed from Davis's, Baicull. Since, also, Dodabetta is near the highest peak of the Neilgherries, about 9,000 ft. above the sea level, while Baicull is close to the seashore, it will be manifest that if the features of the corona depended on the illumination of our own atmosphere, the pictures of Tennant's series would have differed altogether from those of Davis's series. Thus, independently of the spectroscopic evidence, the photographs proved that the corona is a solar appendage, at least as far as those features shown in the two series extend. But they extend from the sun in places to a distance exceeding his own diameter, and amounting in fact to more than a million miles. There is reason to believe that the true solar corona extends much further, and that in reality the zodiacal light (see Zodiacal Light) forms the outer part of the solar corona; so that if the light of the sun could be for a time obliterated without rendering his appendages invisible, we should see the corona merging gradually into the faint glow of the zodiacal light. Mr. Arthur W. Wright of Yale college has succeeded in showing that this light is not emitted from incandescent gas, but reflected from particles or small bodies, and hence derived from the sun.—Another important discovery made during total solar eclipses relates to a solar atmosphere underlying even the sierra. Secchi had observed in 1869 that close to the sun's limb the solar spectrum becomes continuous; this he considered to be due to the existence of a relatively very shallow atmosphere, consisting of the vapors which cause the dark lines of the solar spectrum. For if the brightness of the lines of these vapors corresponds very closely to the brightness of the ordinary solar spectrum for the parts near to the sun's edge, the dark lines of the latter spectrum would be cancelled, and so a continuous spectrum would be produced. For another reason, the present writer had adopted the theory that the atmosphere producing the absorption lines of the solar spectrum must be shallow, compared at least with the dimensions of the sun's globe; for he showed that a shallow and not a deep atmosphere is to be inferred from the darkening of the solar disk near its edge. The opinion thus advanced on theoretical grounds was shown to be correct by the observations of Prof. Young during the total eclipse of December, 1870; for, "directing his analyzing spectroscope to the part of the sun's limb which was to disappear last, he found that at the instant when totality commenced the solar spectrum was suddenly replaced by a spectrum consisting of a thousand soft bright lines." In other words, the vapors which by their absorptive action produce the dark lines of the ordinary solar spectrum were for the moment shining with their own light, and thus produced a spectrum of bright lines. This spectrum continued visible for a few seconds only, showing that the complex atmosphere producing it cannot be more than two or three hundred miles in depth. The observation was successfully renewed during the eclipse of December, 1871, and again during the annular eclipse of June, 1872.—How to account for the supply of the prodigious amount of heat constantly radiated from the solar surface has offered a boundless field of hypothesis. One conjecture

has been that the sun is now giving off the heat imparted to it at its creation, and that it is gradually cooling down; another ascribed it to combustion, and a third to currents of electricity. Newton and Buffon conjectured that comets might be the aliment of the sun, and of late years a somewhat similar theory (first broached by Mr. Waterston in 1853) has been in vogue, viz., that a stream of meteoric matter constantly pouring into the sun from the regions of space supplies its heat, by the conversion into it of the arrested motion. As the sun may indeed derive a small amount of heat from this cause, it deserves more attention than previous conjectures. But conjecture and hypothesis may be said to have given place to views which claim a higher title, as it is now becoming generally recognized, in accordance with modern physical theories of heat, that in the gravitation of the sun's mass toward its centre, and in its consequent condensation, sufficient heat must be evolved to supply the present radiation, enormous as this undoubtedly is. It appears to be susceptible of full demonstration that a contraction of the sun's volume of a given definite amount, which is yet so slight as to be invisible to the most powerful telescope, is competent to furnish a heat supply equal to all that can have been emitted during historical periods. According to this theory then (which is due largely to the development by Helmholtz of Mayer's great generalization), the sun's mass remains unaltered, and its temperature nearly constant, while its size is slowly diminishing as it contracts; so slowly, however, that the supply may be reckoned on through periods almost infinite as measured by the known past of our race, and which are in any case to be counted by millions of years. It would appear from early measurements of Secchi that the different portions of the solar disk do not radiate heat in uniform degrees, and his tables show that the equatorial regions are slightly hotter than the polar. It has been explained that the rapid decrease of brightness toward the edge of the sun obliges us to admit the existence of a shallow atmosphere around it. Prof. Langley has recently published tables from more extended measurements, showing the rate of absorption both of heat and light, the latter being greater than the former. As he does not now find the difference between the equatorial and polar heat observed by Secchi in 1852, the latter concludes from a comparison of his own observations with Langley's, that great changes occur in the distribution of the heat on the sun's surface. Prof. Langley has further shown that this atmosphere absorbs one half of the sun's total radiation, and he considers that its function in the solar emission is of great importance to us. A slight alteration in the thickness of this obscuring envelope would induce changes on the earth greater than those known to have occurred in its climate in past geologic epochs, which may themselves not impossibly have been due to this hitherto unrecognized cause. M. Fizeau has found that the chemical rays are similarly reduced in amount toward the edge of the solar disk, a fact which is also abundantly shown by the darkening near the edge of photographic sun pictures, like those by Rutherfurd and De la Rue.—To sum up briefly the received hypotheses of the physical constitution of the sun: Of its internal structure we know nothing, but we can infer from the low density of the solar globe as a whole that no considerable portion is solid or liquid. The regions we examine appear to consist of cloud layers at several levels floating in a complex atmosphere, in which probably most of the elements are known to us, and certainly many of them exist in the form of vapor. Outside this complex atmosphere extend envelopes of simpler constitution, though into them occasionally arise the vapors which ordinarily lie lower down. The sierra, for instance, consists in the main of glowing hydrogen gas, and that gas, whatever it may be, which produces the line near the orange-yellow sodium lines. The prominence region may be regarded as simply the extension of the sierra. The inner corona is still simpler than the sierra so far as its gaseous constitution is concerned; but here meteoric and cometic matter appears, extending to the outer corona and to great distances beyond even the visible limits of the zodiacal. Returning to the photosphere, we find it subject to continual fluctuations, both from local causes of agitation and from the subjacent vapor acting by its elasticity to burst through it; the faculæ, which are found to be above the general level of the photosphere, are taken to be heapings up of the luminous matter like the crested surges of the sea. All the strata are subject to great movements, which sometimes have the character of uniform progression analogous to our trade winds, and sometimes are violent and resemble in their effects our tornadoes and whirlwinds. Eruptive action appears to operate from time to time with exceeding violence, but whether the enormous velocities of outrush are due to true explosive action (which would compel us to believe that the sun is enclosed by a liquid shell, so as to resemble a gigantic bubble), or to the uprising of lighter vapors from enormous depths, as heated currents rise in our own atmosphere, is not as yet certainly known. (See p. 901.)

**SUN BIRD**, the name commonly given to the *promeropidæ*, a family of tenuirostral birds, with a long, slender, and usually curved bill, the nostrils placed at the base and covered with a scale, wings of moderate size, and short tarsi covered with broad scales. They inhabit the tropical regions of both hemispheres; the subfamily *promeropinæ*, including by far the most species, is confined to the old world, and the *cœrebinæ* to the new. The true sun birds belong to the former, and have a long, slender, curled, and sharp bill, sometimes finely serrated on the margins; the tail is long, the central

feathers often exceeding the rest. They are found in the islands of the Pacific and Indian oceans, and on the continents of Africa and Asia; they are the humming birds of the old

Fiery-tailed Sun Bird (Nectarinia ignicauda).

world, having similar habits and the same brilliant colors, but are larger. The genus *nectarinia* (Illig.) contains more than 100 species, mostly African. The nest, of an elegant form, is usually suspended from the end of a twig, with an opening at the side; the eggs are two to four. The *cœrebinæ* or guitguits have a shorter, broader, and nearly straight bill, and long pointed wings; they are found in tropical South America and the West Indies; the plumage is very beautiful. The nest is protected by a long funnel or by two compartments against insects, birds, serpents, and lizards.

**SUNBURY,** a borough and the capital of Northumberland co., Pennsylvania, on the E. bank of the Susquehanna river, 42 m. N. of Harrisburg, and 114 m. N. W. of Philadelphia; pop. in 1870, 3,131. It has a daily and three weekly newspapers, and several manufactories and machine shops. It is connected by rail with Philadelphia and the Shamokin mining region, and about 200,000 tons of coal are shipped annually.

**SUNBURY,** a S. central county of New Brunswick, Canada, intersected by the St. John river; area, 1,203 sq. m.; pop. in 1871, 6,824, of whom 2,839 were of English, 2,655 of Irish, and 552 of Scotch origin or descent. The surface is nearly level; the soil is fertile and heavily wooded. The European and North American railway and Fredericton branch traverse the county. Capital, Oromocto.

**SUNDA ISLANDS,** a former designation of those islands of the Indian archipelago which surround the Java sea. They were divided into the greater and the lesser Sunda islands, the former including Sumatra, Borneo, Celebes, and Java, and the latter the chain of islands which extends from the E. extremity of Java to Papua, exclusive of the Moluccas.

**SUNDA STRAIT,** an arm of the sea between the islands of Sumatra and Java, which leads from the Indian ocean to the Java sea. The length of the channel upon the Sumatra side, from Flat point, in lat. 5° 59′ S., to Hog point, is about 85 m.; and upon the opposite coast, from Java head, lat. 7° 5′ S., to Bantam point, about 100 m. The breadth of the strait where it joins the Indian ocean is about 70 m., and at the end next the Java sea about 20 m.

**SUNDAY** (Sax. *Sunnan dæg*), the first day of the week, identical with the Roman *dies Solis* (day of the sun). The keeping of this as a sacred day, in memory of Christ's resurrection and of the descent of the Holy Ghost, dates from the beginning of Christianity. It is probable that the first Jewish Christians kept this day holy, while conforming also to their legal sabbath. It was called the Lord's day in all the churches; but it was also popularly designated as Sunday as soon as the gentile element began to prevail. According to De' Rossi, the first monumental inscription calling it the Lord's day is of the year 403. Its first official recognition is in an edict of Constantine in 321, ordering that all work should cease in the cities "on the venerable Sunday," but permitting necessary husbandry to be attended to. The Theodosian code prescribed that "on the Sunday, rightfully designated by our ancestors as the Lord's day, all lawsuits and public business shall cease." (See LORD'S DAY.)

**SUNDAY SCHOOLS.** The earliest recorded Sunday schools were the schools of catechumens, organized, according to Tertullian, in A. D. 180, though less formal instruction of Christian children and novitiates prevailed earlier. The schools of the catechumens flourished till the 6th century. In 1527 Luther established Sunday schools in Wittenberg for the instruction of children who could not attend the day schools. In 1560 Knox inaugurated them in Scotland. In 1580 Archbishop Borromeo of Milan established a system of Sunday schools throughout his diocese, and about the same time there were similar schools in France and the Netherlands. In the 17th century the clergy statedly catechised the children in some parishes of England; and Joseph Alleine, author of the "Alarm," opened a Sunday school in 1668. There was a Sunday school in Roxbury, Mass., in 1674, and one in Plymouth, Mass., in 1680. About 1740 Ludwig Häcker established a school in Ephratah, Lancaster co., Pa., which continued until the building was taken for a hospital during the revolution. Modern Sunday schools, however, were originated by Robert Raikes, who in 1781 gathered poor children from the streets in Gloucester, England, and employed female teachers at a shilling a day for their instruction. The children were taught from 10 A. M. to 12; then, after an hour's recess, read a lesson and went to church. After church they repeated the catechism till after 5, and were then charged to go home at once and quietly. Raikes published an account of his work in the "Gloucester Journal" in 1783, which was republished in the "Gentleman's Magazine," and schools upon his plan were soon estab-

lished in the principal towns of England. Scotland had similar schools as early as 1782, and they were established in Ireland in 1785. The London Sunday school society was organized in 1785, and in 16 years it spent £4,000. In 1786 it was thought that there were 250,000 children in Sunday schools in Great Britain. Bishop Asbury established one in Hanover co., Va., in 1786, and Bishop White one in Philadelphia in 1791. In 1790 the Methodist Episcopal conference at Charleston, S. C., resolved to establish schools for whites and blacks. Katy Ferguson, a poor negro woman, is said to have established one in New York in 1793. Samuel Slater opened a Sunday school for his operatives in Pawtucket, R. I., in 1797; and Mrs. Isabella Graham and her daughter, Mrs. Divie Bethune, who had seen the English schools, opened one in a private house in New York in 1801. The important change from paid to volunteer teachers is said to have been adopted by the Methodists at Bolton, England, about 1786. The "Gratis Sunday School Society" was established in Scotland in 1797, and voluntary teaching was general in England in 1800. In 1803 the London Sunday school union was formed, to foster voluntary teaching. Soon the churches began to assume charge of Sunday schools, in the United States about 1809; and the instruction then became more exclusively religious. Schools were opened in the Protestant churches of all denominations in Great Britain and the United States, later among the Roman Catholics, and more recently among the Quakers. Since 1848 special attention has been given to mission schools for the vagrant children of large cities. In 1875 there were 140 Protestant mission schools in New York. As now organized, a Sunday school has a superintendent with various assistants and a number of teachers, each of whom has a class of scholars. The classes are of different grades, but generally study the same Scripture lesson, their study being separate, but all the classes uniting in worship. The session generally continues an hour or an hour and a half. Schools upon this plan have been introduced by English and American missionaries in all lands; but the system has been adopted in the national churches of continental Europe only within the last 20 years. The following table gives the fullest statistics accessible for 1874:

| COUNTRIES. | Begun in | Schools. | Teachers. | Scholars. |
|---|---|---|---|---|
| France | 1854 | 990 | ...... | 41,520 |
| Belgium | 1856 | 34 | 95 | 1,120 |
| Norway and Sweden | 1859 | ...... | ...... | ....... |
| Germany | 1863 | 1,218 | 4,643 | 81,785 |
| Netherlands | 1863 | 520 | 2,111 | 58,000 |
| Italy | 1863 | 58 | 110 | 8,186 |
| Cisleithan Austria | 1872 | 6 | 30 | 300 |
| Hungary | 1872 | 6 | 30 | 350 |
| Switzerland | .... | 600 | 2,096 | 46,370 |
| Spain | .... | 20 | 95 | 1,000 |
| Greece | .... | 8 | 18 | 339 |
| Great Britain and Ireland (estimated) | .... | ...... | 310,000 | 3,050,000 |
| Canada | .... | 4,401 | 35,745 | 271,881 |
| United States | .... | 69,871 | 753,060 | 5,790,683 |

Among the most important societies formed for the promotion of Sunday schools are the following:

| SOCIETIES. | Begun in | Expended for missionary work in 1874. |
|---|---|---|
| London Sunday school union | 1803 | £4,059 |
| American Sunday school union | 1824 | $90,079 |
| Methodist Episcopal Sunday school union | 1827 | $15,781 |

These societies also publish hymn books, books and papers explaining the Bible lessons, and books for the lending libraries, with which most schools are furnished. Sunday school publications are now issued by regular business houses, as well as by church boards and tract societies. (See Tract and Publication Societies.) Conventions of Sunday school teachers have been held in the United States since 1832. A world's convention met in London in 1862. A German national convention was held in Hamburg in 1874. In 1875 there were in the United States 21 state conventions, and a national and international convention. Since 1866 a uniform series of Bible lessons has been widely used in the United States, and since 1872 has been adopted in Europe and in the missionary schools of Asia and Africa. Comments on these uniform lessons have been prepared by distinguished clergymen, translated into many languages, and issued in pamphlets and papers for teachers, and in "lesson leaves" for scholars, in many millions of copies.

**SUNDERBUNDS**, a marshy tract of British India, in Bengal, stretching across the lower part of the delta of the Ganges, between the bay of Bengal and the inhabited parts of the delta, from the river Hoogly to the island of Rabnabad, 158 m., with a breadth of about 75 m.; area, over 7,000 sq. m.; pop. very small. The soil is alluvial, and the whole district is cut up into innumerable wooded islands by rivers and creeks, many of them navigable for vessels of considerable size. The woods swarm with tigers, the waters with crocodiles, and other tropical animals abound. Salt is manufactured from the sea water to a sufficient extent to supply the demand of the lower provinces of Bengal. The Sunderbunds are included within the district of the 24 Pergunnahs.

**SUNDERLAND**, a town and parliamentary borough of Durham, England, at the mouth of the river Wear in the North sea, 12 m. N. E. of the city of Durham and 240 m. N. by W. of London; pop. of the town in 1871, 98,335. The Wear passes through the borough, and is crossed by an iron bridge, high enough for large sailing vessels to pass, which connects Monk Wearmouth with the S. side of the river. The harbor is formed by the mouth of the river, and is protected by piers. The docks on the S. side of the river have an independent entrance to the sea. Ship building amounts in seasons of ordinary prosperity to more than

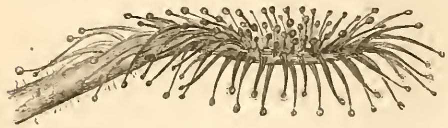
70,000 tons. The entrances in 1873 were 8,091 British vessels, tonnage 1,705,925, and 1,257 foreign vessels, tonnage 268,511; clearances, 8,140 British vessels, tonnage 1,828,094, and 1,299 foreign vessels, tonnage 296,602. The value of exports was £1,615,190. The chief manufactures consist of earthenware and glass, and all kinds of articles required for fitting out vessels. Window glass and glass bottles are very largely manufactured.

**SUNDERLAND. I. Robert Spencer,** second earl of, an English statesman, born in Paris about 1641, died at Althorp, Sept. 28, 1702. After serving as ambassador to Spain and France, he became in 1679 secretary of state. In 1681 he went out of office, but was recalled in 1682, and exercised a controlling influence during the remainder of the reign of Charles II. Under James II. he remained secretary, and was also made president of the council. In 1687 he became a Roman Catholic; but he carried on a secret intrigue with the prince of Orange, and in October, 1688, was dismissed by James. On the arrival of the prince of Orange, Sunderland went to Rotterdam, where he was thrown into prison, but was released by order of William. He then went to Amsterdam, turned Protestant again, and after residing about two years at Utrecht returned to England, although excepted in the act of indemnity. On April 19, 1697, William appointed him lord chamberlain and one of the lords justices; but on Dec. 25 he resigned. **II. Charles Spencer,** third earl of, an English minister, son of the preceding, born in 1674, died April 19, 1722. Professing republican principles, he entered the house of commons in 1695 as member for Tiverton, and continued in the next three parliaments. In 1705 he was sent to Vienna as envoy extraordinary and plenipotentiary, and in 1707 became secretary of state, but was dismissed in 1710. He was generally regarded as the head of the whig party, and on the accession of George I. he was made lord lieutenant of Ireland, in 1715 lord privy seal, and in April, 1717, secretary of state. The house of commons implicated him in the criminal transactions of the South sea scheme; but he was acquitted by a vote of 233 to 172, though with loss of his office. He spent his remaining days in intrigues to effect the downfall of Walpole. By his marriage with the second daughter of the great duke he became progenitor of the present house of Marlborough, their son succeeding as second duke.

**SUNDEW,** the common name of plants of the genus *drosera* (Gr. δροσερός, dewy), which gives its name to the *droseraceæ*, a small order of remarkable plants, one of which, the Venus's fly-trap, is described under Dionæa. There are about 100 species of *drosera*, distributed all over the world, except in some of the Pacific islands; they are perennials, and either stemless, with a rosette of leaves rising from the rhizome, or have stems with alternate leaves; with a few rare exceptions, the leaves bear numerous bristles or hairs, each of which exudes a drop of clear glutinous fluid; this exudation of the hairs, which glistens like dew drops, is recognized in the common and botanical names. Six species are found within the limits of the United States; they are all stemless, with the leaves circinate in the bud (*i. e.*, rolled up from the apex downward), all in a tuft at the base, from the centre of which rises a naked scape bearing the flowers at the top in a one-sided raceme, the undeveloped apex of which droops, leaving the open flower apparently the highest. The white or rose-colored flowers, which open only in sunshine, have in our species their parts mostly in fives, the calyx and corolla withering and remaining in fruit; the globular ovary has three or five styles, so deeply cleft as to appear like six or ten, and ripening into a one-celled, three-valved capsule containing numerous seeds, with a pitted surface. All are found in bogs or wet sands, some very rare and others widely distributed. The most common is the round-leaved sundew (*D. rotundifolia*), which extends from Canada to Florida; its leaves, 1 to 2 in. long, and spreading upon the ground, have an orbicular blade narrowing abruptly into a petiole; the scapes, 6 in. or more high, bear white flowers with their parts sometimes in sixes. The long-leaved (*D. longifolia*), less frequent, but with a similar range, often grows in the water, when its caudex is several inches long; the leaves, more or less erect, have an oblong blade which tapers gradually into the petiole, and are from 1½ to 4 in. long; scape and flowers similar to the preceding. Both of these species are also natives of Europe, the first named extending from northern Spain to the arctic regions and throughout Russian Asia. The short-leaved (*D. brevifolia*) has wedge-shaped leaves only ½ in. long, and white flowers on a scape 3 in. or more high; this and *D. capillaris*, formerly regarded as a long-leaved variety of it, are found only from Florida to North Carolina. The slender sundew (*D. linearis*) is our most local species, being found along Lake Superior and in a few other localities further west; its narrowly linear leaves are 4 to 6 in. long, the blade barely ⅛ in. wide; the scape, at first shorter than the leaves, but at length longer, has white flowers. The thread-leaved sundew (*D. filifolia*) occurs

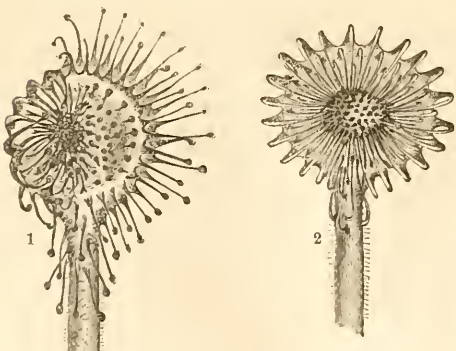
Round-leaved Sundew (Drosera rotundifolia).

in wet sand along the coast, from Plymouth, Mass., to Florida; it has a bulb-like base or corm, from which rise the singular thread-like leaves, from 6 to 12, and sometimes 18 in. long, in which there is no distinction between blade and petiole, having the upper surface



Leaf of Round-leaved Sundew, viewed laterally. (Magnified four times.)

somewhat convex; the scapes, which are a little longer than the leaves, bear handsome rose-purple flowers more than half an inch across. —It was long known in a general way that numerous small insects were caught by coming in contact with these viscid glands, and about 1860 it was discovered that this was not accidental, but that the leaves were especially adapted to the work, and that though their motions are much slower than those of the related *dionæa*, they are none the less effective, and the droseras now rank among the plants which catch and digest insects for their own nourishment. Darwin, in his recent work on "Insectivorous Plants" (1875), gives in great detail the investigations of himself and others upon droseras and a few other genera, but two thirds of the work is devoted to *drosera rotundifolia* alone. The upper surface of the leaf is thickly studded with the glandular hairs already mentioned, to which Darwin gives the name of tentacles; the average number of these on 31 leaves was found to be 192; those on the central part of the leaf are short and erect, with green pedicels; toward




Round-leaved Sundew, seen from above. 1. Tentacles partly inflected. 2. Tentacles entirely inflected.

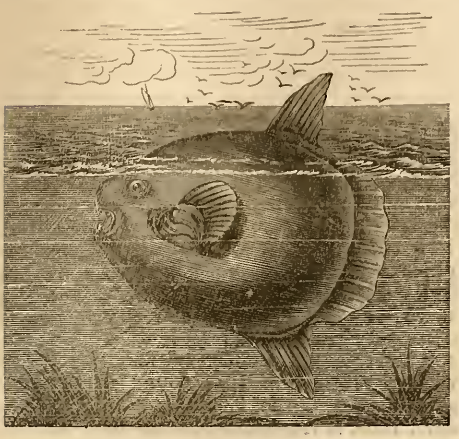
the margin they are larger, inclined outward, and have purple pedicels; those upon the extreme margin project on the same plane with the leaf, and are commonly reflexed, while a few which spring from the top of the petiole are the largest of all, some being ¼ in. long; each tentacle consists of a straight, hair-like pedicel or stalk, consisting of several rows of elongated cells filled with a purple fluid; the gland at the apex is mostly oval and complex, and secretes a colorless and extremely viscid matter, which may be drawn out into long threads. If a small object, organic or inorganic, be placed on the centre of the leaf, the tentacles nearest it begin to bend toward it; this impulse is transmitted to those further off, until all, including the marginal ones, are closely inflected over the object, a process requiring from one to four or five hours. In case an insect alights upon or touches one of these glands, it is held by the secretion, and in its struggles comes in contact with other glands, which hold it until the tentacles can fold over it one by one and completely imprison it. The insects thus caught are actually digested, and the nutritive material absorbed to contribute to the growth of the plant; it is found that the secretion from these glands or

Thread-leaved Sundew (Drosera filiformis).

tentacles has a digestive power closely resembling that of the gastric juice of animals, acting even upon cartilage and the fibrous substance of bone. Experiments with several other species of *drosera* show that, though the leaves vary greatly in shape and appearance from those of *D. rotundifolia*, they differ but little in their functions. Some of the curious results obtained by Mrs. Treat with our thread-leaved sundew are given in the article Insectivorous Plants.

**SUN FISH,** the common name of the fishes of the diodon family and genus *orthagoriscus* (Schn.). The skeleton is soft and only partially ossified; the body short and round, compressed laterally; the skin rough, covered with mucus, but without spines; jaws undivided in the middle, forming a cutting edge; mouth small, the teeth adapted for bruising sea weeds and soft-bodied animals; the body is truncated posteriorly, looking as if it had

been cut off at the dorsal and anal fins and then furnished with a short broad caudal; there are no ventrals, no air bladder, and no abdominal sac capable of distention; the dor-



Common Sun Fish (Orthagoriscus mola).

sal and anal fins are more or less united to the caudal; the stomach is small, and immediately receives the biliary canal. The common sun fish (*O. mola*, Schn.) is almost circular, and the dorsal and anal project posteriorly, with the caudal between; on each side, near the centre, is a small pectoral, and in front of it the gill opening; the gills are arranged in comb-like fringes; it is also called moon fish and head fish. It grows 4 or 5 ft. in length and 3 or 4 ft. in depth, with a weight of several hundred pounds; the flesh is tough and remarkably elastic, owing to the great amount of yellow elastic fibre, intricately interlaced, almost to the exclusion of white fibre and true muscle; the liver is very fat, and its oil is used for lubricating purposes on board ship, and for sprains and bruises among fishermen. It is grayish above and whitish below, with a silvery lustre when alive, and phosphorescent at night. According to Mr. Putnam, in his paper read before the American association for the advancement of science in 1870, the young differ little from the adults in shape, and do not resemble *molacanthus*, as Lütken and Steenstrup have said. It is sluggish in its motions, and is often seen asleep at the surface of the water. In some seasons it is common in summer in Massachusetts and New York bays, and feeds partly if not principally on medusæ. There is probably no fish more infested by parasites, internally and externally.—The name sun fish is also commonly given to many medusæ (see JELLY FISH), and in this country to the bream (see BREAM).

**SUNFLOWER,** the common name of plants of the genus *helianthus*, a word of the same meaning. The genus belongs to the composite family, and consists of about 50 species, most of which are North American; they are coarse annual and perennial herbs, with rough stems and foliage, and some species bear tubers; the opposite or alternate leaves have three nerves; the solitary or corymbose heads are margined by conspicuous neutral ray flowers; the involucre imbricated; the persistent chaff of the receptacle embracing the four-sided akenes (popularly seeds), which bear at the top two chaffy and very deciduous scales, with sometimes two or more intermediate ones. In the common sunflower (*H. annuus*), from tropical America, the flat receptacle is 6 in. or more across, margined by conspicuous yellow ray flowers, while the central portion, or disk, is crowded with brownish tubular ones. The idea that the sunflower is so called because it always presents its face to the sun is erroneous; the name is more likely to be due to the resemblance of the flower head to the old pictorial representations of the sun as a disk surrounded by flaming rays. Few plants are so exhaustive of potash, the constituent in which most soils are deficient, as the sunflower, and its cultivation, sometimes recommended for various uses, would soon render fertile soils unproductive; for this reason it cannot become a profitable crop. It is raised in small quantities occasionally for the seeds (akenes), which make an acceptable variety in the food of poultry, and they are in repute among horsemen as a remedy for heaves, a quart being given daily with the food. Though the seeds yield about 40 per cent. of an oil useful for burning, for soaps, and other purposes, equally good oil may be obtained from plants which do not so exhaust the soil. The abundant pith has been used by French surgeons as a moxa. A so-called double variety, in which the tubular florets of the disk are developed in the same

Garden Sunflower (Helianthus multiflorus).

form as those of the ray, is much more showy than the common kind.—The best garden sunflower is the many-flowered (*H. multiflorus*), a perennial, of doubtful nativity, growing 4 to

6 ft. high, and producing late in summer an abundance of flowers, which in the double form have a close resemblance to the flowers of the dahlia. *H. argophyllus* of Texas, with hoary white foliage, and *H. orgyralis* of the far west, with narrow gracefully recurved leaves, are both sometimes cultivated for the peculiarities of their foliage. Numerous species, of interest to the botanist only, are to be found in all parts of the country, especially on the western prairies. The species cultivated for its edible tubers as Jerusalem artichoke (*H. tuberosus*) is described under ARTICHOKE.

**SUNFLOWER**, a N. W. county of Mississippi, intersected by the Sunflower river; area, 720 sq. m.; pop. in 1870, 5,015, of whom 3,243 were colored. Since the census a portion has been set off to form Leflore co. The surface is level and swampy, and the soil highly fertile. The chief productions in 1870 were 155,672 bushels of Indian corn, 21,091 of sweet potatoes, and 7,028 bales of cotton. There were 839 horses, 849 mules and asses, 1,728 milch cows, 3,497 other cattle, 184 sheep, and 7,828 swine. Capital, Johnsonville.

**SUNGARIA**, or **Dzungaria**. See TURKISTAN.

**SUNNA** (Arabic, custom or rule), a collection of oral traditions of the sayings and practices of Mohammed and his wives, companions, and immediate successors. The believers in them are called Sunnis. They are considered the orthodox Mohammedans, and comprise the four sects of Hanifites, Malekites, Shafeites, and Hanbalites, named after their founders, all of whom recognize the Sunna as of a value second only to that of the Koran, which the Shiahs deny. (See SHIAHS.) The Sunna is also known under the name *Hadis*, "Tradition." While the Shiahs constitute at present the majority of the Persian and Hindoo Mohammedans, the Sunnis, and among them especially the Malekites and Shafeites, are dominant in the Ottoman empire, Arabia, Turkistan, and Africa.

**SUNSTROKE** (Lat. *solis ictus;* Fr. *coup de soleil;* Ger. *Sonnenstich;* also called insolation, heat apoplexy, heat asphyxia, and solar asphyxia), an affection which suddenly attacks persons exposed to the continuous hot rays of the sun or other sources of heat. The symptoms vary considerably, according to the extent and nature of the injury. The patient is usually attacked in the midst of his employment, although sometimes he is not seized till in the night, especially if occupying heated and badly ventilated quarters. There is loss of consciousness, and generally stertorous breathing and convulsions, and in the worst cases there is extreme prostration of the vital powers, and the voluntary muscles are motionless from the paralyzed condition of the nervous system, the greatly impeded functions of respiration and circulation being the only signs of life. The attack usually comes on in the afternoon, partly because this is the hottest part of the day, and also because the subject has generally been laboring for many hours, and his vital powers are more or less exhausted. The attack may be immediately preceded by premonitory symptoms, such as pain and a feeling of fulness in the head and oppression at the pit of the stomach, sometimes attended with nausea and vomiting, and a feeling of weakness in the lower extremities, vertigo, and dimness of vision. In 60 cases reported to the New York hospital by Dr. H. S. Swift ("New York Journal of Medicine," 1854), surrounding objects appeared of a uniform color, generally blue or purple, but sometimes red, and at others green. In light cases the insensibility may be momentary, but in severe cases the patient rapidly becomes asphyxiated or comatose. The pupils are sometimes dilated and sometimes contracted, and there may be dilatation and contraction at different stages in the same case. There is considerable and often very great increase in the temperature of the body. In cases observed at Bellevue hospital, New York, in July, 1868, it frequently rose to 109·5° F., and in one instance to 110·5°; and still higher temperatures are recorded. When it reaches 107° recovery is scarcely to be expected, although it took place in the one instance at Bellevue where it reached 110·5°. Vomiting during the unconscious period, and involuntary evacuation of the bowels, are very grave symptoms. Although in many cases, as has been observed, the symptoms vary with the extent of the lesions, in the more pronounced cases they are rather uniform, the patient being completely without sensation or motion, except that of respiration, which is stertorous, though less than in true apoplexy. The eyes are fixed and turned upward with a glassy appearance; the pupils are greatly contracted, and the conjunctivæ are congested. Sometimes the whole system of voluntary muscles will be convulsed, and more rarely the patients appear to be in a state analogous to somnambulism; but the more fatal cases are often entirely free from motion of the voluntary muscles. In reports of cases occurring in the British army in India, by Mr. Longmore, in which he designated foul air of badly ventilated quarters as an active cause, the pathological conditions found after death were markedly more those of asphyxia than of congestive apoplexy, there being excessive engorgement of the lungs, while the cerebral congestion was decidedly less. The blood remains uncoagulated after death, showing a loss of life in its organic constituents. Thus, the post-mortem appearances accord with the symptoms, illustrating, as Mr. Barclay has pointed out, the four different ways in which death may take place, and furnish a key to the rational treatment of the different cases. 1. The intense heat of the sun's rays, pouring down upon the head, combined with great bodily exertion, may produce a state similar to that of nervous concussion from accident, and death may take place more or less sud-

denly by syncope. 2. When death does not quickly ensue, paralysis of the respiratory nerves may induce pulmonary congestion, terminating in asphyxia. 3. The cerebral may be much greater than the pulmonary congestion, and death may take place by coma. 4. Partial recovery may supervene, and the patient die in two or three days afterward, with serous effusion within the cranial cavity. Rather more than half the cases of sunstroke are fatal, death sometimes occurring in a few minutes, but oftener in a few hours, the average perhaps being from three to four, the patient remaining in a comatose state till the end of life.—The treatment has been a matter of much discussion, and for cases having marked apoplectic or comatose symptoms it is so still. Some contend that bloodletting may be advantageously employed, while others strongly oppose it in all cases, maintaining that there is always a degree of vital depression which forbids it. This is the position generally held by the surgeons of the English army in India. The principal remedies relied upon in nearly all countries are stimulation to the surface, especially along the spine, by sinapisms or blisters and electricity, and the administration of stimulant and purgative enemata containing alcoholic spirits; the bathing of the surface of the body with tepid or warm water containing ammonia or carbonate of soda; and the application of the cold douche to the spine and of cold to the head. The hair should be cut short, and in the worst cases blisters may be applied to the nape of the neck and along the spine. When the breathing is very difficult and the bronchial tubes are clogged with mucus, the patient should be often turned upon the side and face. Beneficial effects have sometimes been found from the inhalation of chloroform, but the use of this requires great caution. Promptness and decision are necessary, and the services of a physician should be procured as quickly as possible; but cold to the head, sinapisms, and stimulating enemata may be employed before his arrival.

**SUPERCARGO**, a person who accompanies a cargo shipped to a foreign port, and is intrusted with the sale of it there, either as specially directed or to the best advantage, and with the investment of its proceeds in a proper cargo for the home or other market. As the supercargo's authority properly concerns the cargo, it is ordinarily dormant during the voyage, and is called into exercise by arrival at the foreign port; and though for the sake of the cargo and a market the supercargo may sometimes have the authority to determine the destination of the ship, yet he has none to interfere in the navigation of her, or in any respect to usurp the office and functions of the master. The powers and duties of a supercargo are not very specifically regulated by law or usage, but are determined in every instance by the express instructions of the shipper where such instructions are given, as they usually are. The supercargo is simply an agent, and is limited like other agents to the authority vested in him by his principal. Yet, by construction of the law, new authority is conferred upon the supercargo by the existence and force of necessity; and it has been expressly held that if by any sudden emergency it becomes impossible for the supercargo to comply with the precise tenor of his instructions, or if a literal execution of them would defeat the objects of the shipper and amount to a sacrifice of his interests, it then becomes the duty of the supercargo to do the best he can for the shipper; and his acts done *bona fide* and with a reasonable discretion, in such an exigency, are binding upon the latter. A supercargo, like a master or foreign factor, generally buys and sells in his own name, and his acts in a foreign port, even after the death of the owner of the cargo, and while that event was unknown to him, are binding upon all parties.

**SUPERIOR, Lake,** the uppermost of the great border lakes of the United States and Canada, and the largest body of fresh water on the globe. It is included between lat. 46° 30′ and 49° N., and lon. 84° 50′ and 92° 10′ W.; greatest length from E. to W. 360 m.; greatest breadth, across its central portion, 140 m.; area, 32,000 sq. m. Its length of coast is about 1,500 m., its mean depth about 1,000 ft., and the level of its surface above the sea about 630 ft. The boundary line between Canada and the United States passes from Lake Huron up the St. Mary's river, the outlet of Lake Superior, through the centre of the lower half of this lake, to the mouth of Pigeon river on the N. shore, between Isle Royale and the Canadian coast. This island was allowed to fall on the American side of the boundary in compensation for one of the islands at the mouth of the St. Mary's river. The S. coast of the lake from the outlet to Montreal river belongs to the upper peninsula of Michigan. From this river to the river St. Louis the coast belongs to Wisconsin, and thence round to Pigeon river to Minnesota. Toward each extremity the lake contracts in width, and at the lower end terminates in a bay which falls into the outlet, the St. Mary's river, at the two opposite headlands of Gros Cap on the north and Point Iroquois on the south. Thence to the mouth of the St. Mary's at Lake Huron is about 60 m. Numerous streams flow into Lake Superior, but none of large size. High lands in general lie near the coast, the long slopes from which are directed away from the lake and the short slopes toward it. The rapid fall prevents the navigation even by canoes of most of these streams, but provides excellent water power, which is almost everywhere available. The principal rivers are the St. Louis, which enters at the head of the lake; on the N. shore, the Pigeon, Kaministiquia, Black Sturgeon, Nipigon (the outlet of Nipigon lake), Pic, and Michipicoten; and

on the S. shore, the Tequamenon, Sturgeon, Ontonagon, Montreal, and Bad. The coast of the lake is for the most part rocky, and on the N. side is much indented by deep bays surrounded with high rocky cliffs, back of which the country soon rises in bleak and dreary mountains. Numerous islands are scattered about this portion of the coast, many rising precipitously to great heights directly up from the deep water. Some present castellated walls of basalt, and some rise in granitic peaks to various elevations up to 1,300 ft. above the lake. Nowhere upon the inland waters of North America is the scenery so bold and grand as on the N. shore of Lake Superior. The irregularities of the coast with the general depth of water here afford numerous good harbors, which however in this unfrequented region are as yet of little service, while on the opposite coast such places of refuge are much wanted. The determination of the coast lines by the wearing action of the waters upon rocks of different degrees of hardness is remarkably exemplified everywhere along the shores of Lake Superior, particularly in the precipitous walls of red sandstone on the S. coast, famous in all the earlier accounts of the lake as the "Pictured Rocks." They stand opposite the greatest width of the lake and exposed to the greatest force of the heavy storms from the north. The effect of the waves upon them is not only seen in their irregular shapes, but the sand derived from their disintegration is swept down the coast below and raised by the winds into long lines of sandy cliffs. At the place called the Grand Sable these are from 100 to 300 ft. high, and the region around consists of hills of drifting sand. The principal bays are Thunder, Black, and Nipigon on the north, Tequamenon at the outlet, Keweenaw on the south, and Fond du Lac at the head. The largest islands are Isle Royale and Michipicoten. The most important places on the shores of the lake are Marquette, Mich., and Duluth, Minn. There are many varieties of excellent fish, the most valuable being white fish, sturgeon, and trout.—For the mineral productions of the Lake Superior region, see Copper Mines, vol. v., p. 323; Iron Ores, vol. ix., p. 407; Michigan, vol. xi., p. 497; Ontario, vol. xii., p. 635; and Silver, vol. xv., p. 57.

**SURAJAH DOWLAH.** See Clive, and India, vol. ix., p. 210.

**SURAT,** a walled town of British India, in the northern division of Bombay, in a collectorate of the same name (pop. in 1872, 554,000), on the left bank of the river Taptee, 20 m. from its mouth in the gulf of Cambay, and 150 m. N. of Bombay; pop. about 70,000. It contains an English church, several handsome mosques and temples, numerous Hindoo and other schools, and the Banian hospital, founded and richly endowed by the Jains for the treatment and cure of diseased animals. The city is an organized municipality, with a revenue of nearly £50,000.—Surat is of great antiquity, and is mentioned in the ancient Sanskrit poem, the *Ramayana.* When the Mohammedans ruled Hindostan it was their chief port of embarkation on their pilgrimage to Mecca. The Portuguese sacked Surat in 1530. In 1613 the English obtained commercial privileges from the emperor Jehanghir, and established a factory here which became their chief station on the W. coast of India, and remained so till 1686, when it was removed to Bombay. In 1796 the population was estimated at 600,000, and it had then greatly declined in consequence of the loss of its trade. In 1800 the administration of the government was permanently assumed by the British.

**SURETY,** in law, a person who binds himself to fulfil, either wholly or in part, the engagement of the principal obligor. For those cases in which the surety expressly assumes the obligation technically known as a guaranty, see Guaranty. When two parties join in making a purchase, or in giving a promissory note, each is in law equally liable to the party with whom the contract was made; but as between themselves, it is always competent for one to show that the transaction was wholly for the benefit and at the request of his co-obligor, and that he became bound as surety merely for his associate. If in such case the surety in face be compelled (as, according to the tenor of his obligation, he obviously may be) to pay the whole, equity declares that he is entitled to complete reimbursement from the principal, and that, in order to secure this reimbursement, the surety is entitled to the benefit of all the security which either the rules of law or the express acts of the parties have given to the obligee or creditor; and if, by any negligence or other acts, the obligee defeat these rights of the surety, he forfeits his right of action against him. If the creditor or obligee is fairly informed of the relation of principal and surety existing between the parties, he is bound to take care that no act of his shall destroy or lessen the surety's right of indemnity from the principal debtor. If therefore he declare that he will look solely to the principal for payment, so that the surety is induced to omit taking security from the latter; or if he tell the surety that the debt has been paid so that he relinquish to the principal his security; the surety will be in both cases discharged from his obligation to the obligee. But the mere inaction of the creditor to pursue his remedies against the principal will not discharge the surety, nor will positive indulgence to the principal have this effect; but if the delay be granted in pursuance of any binding agreement with the principal, so that the surety cannot pay the debt and then proceed at once for indemnity against the principal, the creditor's act releases the surety. And as the surety is entitled to the benefit of all securities given by the principal, he is discharged if the creditor's inaction or negligence have rendered these securities valueless. In short, though the

creditor is not bound, so far as the surety is concerned, to pursue the ordinary legal remedies against the principal, yet he is bound, in respect to all remedies given him by way of pledge or security or by other act of the parties, to hold or pursue them diligently in behalf of the surety; and if he relinquish any such remedy without the knowledge or against the will of the surety, he shall lose his claim against the latter to the extent of the right surrendered. Question has often been made whether the creditor would not lose his right against the surety if the principal should become insolvent after a request by the surety (which was disregarded) that proceedings be immediately taken for collection; but it has generally been held that he did not, and that the remedy of the surety was to pay the debt and then proceed to collect of the principal.

**SURF BIRD** (*aphriza virgata*, Gray), a wading bird of the plover family, and subfamily *cinclinæ* or turnstones. The bill is about as long as the head, with vaulted obtuse tip and compressed sides; wings long and pointed, with the first quill the longest; tail moderate and even; tarsi as long as middle toe, robust, with small irregular scales; toes long, free at the base, sides of anterior ones margined, and hind one elevated, slender, and partly resting on the ground. It is about 10 in. long, with the wing 7 in.; dark brown above, lighter on the wing coverts, with white spots and stripes on the head and neck; upper tail coverts and basal half of tail white, the latter terminated with brownish black; under parts white, tinged with ashy in front, each feather having a brownish black crescent. It is found on the Pacific coast of North and South America, and in the Hawaiian islands, and is migratory.

**SURGEON,** a bird of the stork family. See JACANA.

**SURGERY,** or **Chirurgery** (Gr. χείρ, the hand, and ἔργον, labor), that department of the art of healing which appertains to the diagnosis, prognosis, and treatment of the class of diseases which require manual or instrumental measures for their cure. The sphere of surgery is more limited and at the same time more accurately defined than that of medicine. Surgery divides tissues or parts improperly united, and unites those which have been divided when they should remain in union; separates whatever has become dangerous or inconvenient to the patient; removes foreign bodies, or parts of the body which from disease or loss of vitality have become foreign, whenever they exert a hurtful influence on the animal economy; restores to their cavity or replaces in their normal position portions of the body which have become displaced; checks the loss of blood from wounded or divided blood vessels; reduces inflammations, or removes the purulent or phlegmonous matter which may have been deposited by them; repairs and corrects deformities and distortions; and effects the replacement of lost tissues. Its means of accomplishing these results are the hand, lint, bandages, and apparatus of various kinds, cutting, crushing, and probing instruments, catheters, bougies, sounds, forceps, specula, &c., and the various forms of cauteries, direct and indirect, liquid and solid.—The earliest surgeons of whom there is any record were the Egyptian priests. According to Herodotus, we owe to them the use of the moxa and the adaptation of artificial limbs. Among the ancient Hebrews there is but little evidence of surgical skill, and that little was confined to the priests. In Greece, surgery is as ancient as the mythic period of its history. Chiron the centaur, born in Thessaly, and skilful in the application of soothing herbs to wounds and bruises, is the legendary father of Greek surgery. But Æsculapius, the son of Apollo, said by some to have been the pupil of Chiron, though others call him his predecessor and superior, won the highest fame in that early time for surgical skill. He is said to have been deified on account of his wonderful success about 50 years before the Trojan war. Temples were reared for his worship, which became the repositories of surgical knowledge, at Epidaurus, Rhodes, Cnidus, Cos, and Pergamus. Homer has immortalized his two sons, Podalirius and Machaon, the companions of Agamemnon in the Trojan war, where they rendered essential service in healing the wounds of the Grecian heroes. The Asclepiades, or reputed descendants of Æsculapius, retained the monopoly of surgery as well as medicine in their family. They had established in this period three schools of medicine, at Rhodes, Cnidus, and Cos. Pythagoras, in the 6th century B. C., established at Crotona a new school of medicine, in which his peculiar philosophy was probably applied to the art of healing; among its early pupils was Democedes, eminent as a surgeon, who when taken captive by the Persians reduced the dislocated ankle of Darius, and removed or in some way cured the cancerous breast of his queen Atossa, after the Egyptian physicians had failed. The want of anatomical knowledge, no dissections being allowed, was a fatal bar to any considerable progress in surgery. Hippocrates (about 400 B. C.) more than any of his predecessors advanced surgical treatment; he reduced dislocations and adjusted fractures, used the trephine, applied the forceps in accouchement, made incisions into the kidney for the removal of calculi, performed amputations, and perforated the cavity of the ribs in empyema and hydrothorax. Interdicted from human dissection, he practised the dissection of the ape tribe as nearest to man in anatomical structure, and thus obtained much knowledge. For a century after the death of Hippocrates we meet few names of note in surgery. The founding of the Alexandrian school under Ptolemy Soter about 300 B. C. was another important epoch in the advance of the art. Herophilus and Erasistratus, the

two great leaders of the medical school of that university, if it may be so called, were eminent both as physicians and surgeons; with them commenced the practice of human dissections. The extirpation of the spleen, and the application of remedies direct to scirrhosities and tumors of that viscus and of the liver, were among the bold operations of Erasistratus. To him also belongs the invention and application of the catheter in cases of retention of urine. The pupils of these eminent surgeons invented bandages of peculiar forms, and introduced the tourniquet and contrivances for reducing dislocations of the femur. One of them, Ammonius, employed an instrument for lithontriptic purposes, anticipating Civiale's process.—Rome in the first 700 years of its history produced no surgeon of note. Celsus, who flourished about the beginning of the Christian era, was the greatest of the surgeons of ancient Rome, and his observations on injuries of the head, on cataract, on the ligature of wounded arteries, hernia, lithotomy, fractures and dislocations, amputations, and carbuncle, show considerable knowledge. Aretæus, the first to use the cantharides blister, Heliodorus, Rufus the Ephesian, all of whom flourished between A. D. 50 and 120, and after them Antyllus, added to the surgical knowledge of the time new views of the treatment of injuries of the head, the resort to arteriotomy instead of venesection in sudden emergencies of inflammatory action, bronchotomy in some acute diseases of the throat, the radical cure of hydrocele by free incision of the parts, and a more thorough investigation of diseases of the kidneys and bladder. Galen devoted more attention to medicine than surgery, but his observations on hernia, on luxation of the femur backward, and on the application of the trephine to the sternum in empyema, are of importance. In the early period of Christianity surgery languished; the early Christians opposed dissection as strongly as the pagans, and by attributing the power of healing wounds to martyrs and their relics discouraged all efforts at improvement in surgical science. The first eminent name among the surgeons of the dark ages is Aëtius (500 to 550), whose surgical writings are numerous and valuable. He practised scarification of the extremities in anasarca, operated for aneurism, endeavored to dissolve urinary calculi by internal remedies, discussed hernia with great ability, and wrote on encysted tumors, injuries to nerves and tendons, diseases of the eyes, &c. Alexander of Tralles, a younger contemporary of Aëtius, wrote treatises, now lost, on diseases of the eye and on fractures, which were highly commended for their originality by some of his successors. Paulus Ægineta, in the 7th century, was a surgeon of eminence and considerable originality. His sixth book has been considered by many as the best body of surgical knowledge prior to the revival of letters. He recommended topical in preference to general bleeding, as more effective in reducing local inflammation; resorted to copious venesection to accelerate the painful descent of calculi through the ureters; opened internal abscesses with caustics; defined the points for performing paracentesis in ascites; made his incision in lithotomy on one side of the raphe instead of the centre as Celsus had recommended; practised both laryngotomy and tracheotomy, the latter as a means of carrying on respiration during occlusion of the larynx; treated of fractures of the patella; and was the originator of the obstetric operation of embryotomy.—The Arabian physicians, who rose into distinction as those of the West declined in reputation, did little for surgery. Rhazes (about 900) described for the first time *spina ventosa* and *spina bifida*, cauterized the wounds from the bites of rabid animals, opposed the use of the knife in cancer except when limited and when the whole tumor could be removed, and gave a clear and satisfactory description of the treatment of hernia. Avicenna (died about 1036) introduced the flexible catheter. Albucasis (died about 1106) introduced an instrument for the cure of *fistula lachrymalis*, invented the probang, and in wounds of the intestine practised union of the divided parts by suture with success.—In Catholic Europe medical practice and what of surgery remained was mostly in the hands of the clergy until, by the edict of the council of Tours in 1163, they were interdicted from all surgical practice. The Jews were at this period and for a century or two later in high repute as physicians, but they seem to have had a dislike to surgery. Guy de Chauliac, a priest, compiled from the Greek and Arabian authors the earliest work of modern times on surgery, but with very little judgment of what was worth retaining. For two centuries and more surgery was mainly in the hands of the illiterate barber surgeons. The revival of surgical science dates from the appearance of Vesalius (died 1564) as a teacher of anatomy in Italy, followed soon after by Fallopius and Eustachius. Surgery was then for the first time put upon a sound and scientific basis, that of careful dissection, and Ambroise Paré, a French army surgeon who had educated himself in anatomical science, was the first of its great lights. He was surgeon successively to four kings of France, and was attached to the French armies as surgeon-general down to 1569. To him we owe the revival and improvement of the practice of tying the arteries after operations or wounds, instead of cauterizing them with hot iron or boiling oil. The pupils of Paré added little lustre to their master's name; but in Italy at the close of the 16th century Fabricius ab Acquapendente flourished at Padua, and his *Opera Chirurgica*, the first really valuable treatise on surgery of modern times, passed through 17 editions. He was the preceptor of Harvey. Wiseman, sergeant surgeon to Charles II., was the first eminent sur-

gical writer and practitioner in England. His recommendation of immediate amputation in military practice, when the preservation of the limb was impossible, has been followed from that time to the present. He left eight treatises on surgery, which are not without value even at the present day. The flap operation in amputation is claimed for James Young, an English surgeon contemporary with Wiseman, and also for two French surgeons, Verduin and Sabaurin, of the same period. In Germany during this century, Hildanus, Scultetus, Purmann, and Heister were the principal surgical writers and practitioners. In Italy the principal names of note toward the close of the 16th and in the 17th century were Taliacotius, the originator of the restorative surgery in Europe; Cæsar Magatus, who greatly simplified the treatment of wounds; and M. A. Severinus, who banished the salves and plasters which in Italy had usurped the place of operations. The 18th century witnessed a still greater advance in the science. In England, Percival Pott, well known for his investigation of that form of caries of the vertebra known by his name (see SPINAL DISEASES), and the most judicious writer of modern times on fractures, amputations, injuries of the head, and diseases of the spine; John and William Hunter, the former the greatest master of the principles of surgery in the profession; Cheselden and Douglas, both famous as lithotomists; and the two Monros, father and son, are among the great names of the surgical profession. In France flourished La Peyronie, at whose instance Louis XV. in 1731 founded the academy of surgery; Jean Louis Petit, the greatest French surgeon of the 18th century; Ledran, Garangeot, and the illustrious Desault, the originator of clinical surgical instruction and the inventor of numerous admirable apparatuses for the treatment of fracture. Among the celebrated surgeons of other European countries were Molinelli, Morgagni, Scarpa, Bertrandi, and Moscati in Italy; Deventer, Albinus, and Camper in Holland; and Platner, Röderer, Rambilla, Theden, and Richter in Germany. During the 18th century the ligature of aneurismal arteries of large size, the treatment of hernia and *fistula in ano*, the cure of *fistula lachrymalis*, and the skilful management of dangerous and difficult parturitions, were the most important branches of surgery in which there was a material advance from the preceding century; the proper construction of instruments also received great attention. The 19th century has, however, done more for the improvement of this science than all the centuries which have preceded it. In England, Abernethy, Sir Astley Cooper, Liston, and others of the highest reputation have passed away, and others hardly less eminent remain; in France, Dupuytren, Roux, Lisfranc, and Larrey have had no superiors either before or after them. The following may with propriety be particularized as among the improvements of the age in surgery: the introduction of anæsthesia; resection of the bones at the joints; the preservation of the periosteum and consequent development of new bone; partial amputations of the foot, as instanced in the operation of Lisfranc for the removal of the metatarsus, and of Chopart, Symes, Malgaigne, and Pirigoff for disarticulation of tarsal bones; the amputations at the thigh and shoulder joints; the ligature of arteries within the trunk and immediately at their departure from it; the resection and removal of portions or even the whole of the upper or lower jaw; the operations for cleft or deficient *velum palati* or palatine vault; the opening by longitudinal section of the air passages at different points to avoid asphyxia; the resection and extirpation of the uterus, of the ovaries, and of the lower portion of the rectum; the introduction of the silver suture, especially in operations on the viscera, as for recto-vaginal and vesico-vaginal fistulæ; the adoption of the immovable apparatus for fractures; the processes for remedying disunited fracture; the substitution of milder means for the trephine in all except the most serious cases; the improved treatment of ulcers and abscesses; the cure of the most formidable aneurisms by the ligature of the carotid, subclavian, axillary, humeral, and external and internal iliacs; the treatment of varicose veins; the successful treatment of calculus by lithotrity, in consequence of the great improvements made in the processes and instruments; the diagnosis and treatment of tumors, whether encysted, fatty, vascular, or malignant; the cure of strabismus, and the generally improved treatment in diseases of the eye, including the invention of the ophthalmoscope by Helmholtz in 1851, and the reformation of ophthalmic medicine and surgery carried on by Von Graefe, Donders, Bowman, Toynbee, Wilde, Von Tröltsch, Politzer, and others; the restorative processes, by which the nose, lip, and other parts are reformed from adjacent tissues; the treatment of harelip and of club-foot; and the notable advance consequent upon the conservative treatment of gunshot and other wounds of the brain.—As from the nature of their duties suits for malpractice are more often brought against surgeons than against physicians, it will be appropriate here to speak of their legal obligations, though the same laws apply to practitioners in any of the branches of medicine. In undertaking the treatment of a patient, the surgeon enters into a legal obligation and assumes legal liabilities, which, though seldom expressly defined, are yet, in the apprehension of the law, fixed and certain. The law holds that he contracts for the possession of that reasonable degree of learning, skill, and experience which the members of his profession ordinarily possess. Those also who, like oculists, aurists, or dentists, claim to be particularly conversant with and skilful in the treatment of the diseases of single organs, must be held

to a peculiar responsibility. The same is true of surgeons of great pretensions in large cities as compared with those residing in remote and thinly settled districts. In undertaking a case, the surgeon also contracts that he will apply the skill which he possesses, whatever be its degree, with reasonable and ordinary diligence and care. Extraordinary care is no more implied than extraordinary skill; nor is the practitioner supposed to guarantee a cure, though he may if he chooses contract to effect a cure, and then he must answer for a failure. The practitioner's skill in any case will ordinarily be required to embrace those phases and phenomena which usually characterize the dominant disease; and any mischance which connects itself immediately with these will involve the question of skill. His diligence and care will be exercised in watching for and guarding against the accidental influences which, if overlooked, may delay or even prevent the restoration of the patient. If he have brought ordinary skill and care to the treatment of his case, the surgeon is not responsible for want of success nor for mistakes in cases of real doubt and uncertainty. The surgeon's liability in cases of malpractice is ordinarily only a civil one, and the injury he does can usually be compensated by damages. But, in cases where death has followed the treatment, and it has seemed to be the direct consequence of the treatment, there have been, not unfrequently, charges of criminal malpractice preferred against the medical practitioner. To constitute a crime, there must be a malicious or criminal intent. This intent may exist in an actual design, or the law will infer it from gross rashness or want of circumspection.—Where no statutory prohibition intervenes, all regular and irregular practitioners are to be placed on the same footing. Leaving out of consideration cases of express malice, which would hardly be included under the designation of malpractice, our topic is reduced to those cases in which the charge is founded upon gross ignorance, gross negligence, or gross rashness. With particular reference to the charge of manslaughter, the law, especially in England, is that "if one, whether a medical man or not, profess to deal with the life or health of another, he is bound to use competent skill and sufficient attention; and if he cause the death of the other through a gross want of either of these, he will be guilty of manslaughter;" or as an eminent American authority, Mr. Bishop, states the law: "The carelessness in a medical man which, if death follow, will render him liable for manslaughter, is gross carelessness, or, as it is more strongly expressed, the grossest ignorance or most criminal inattention."

**SURICATE,** a carnivorous mammal of South Africa, coming near the ichneumons. It is the *ryzæna (suricata) capensis* (Ill.), and is sometimes called zenick. It is about a foot long, with a tail of 6 or 8 in., and about 6 in. high; it is nocturnal, dwelling in burrows which it excavates with its stout claws; the color is grayish brown, tinged with yellow, with obscure dark bands across the back. It is docile

Suricate (Ryzæna capensis).

and intelligent, and is often domesticated for the destruction of vermin.

**SURINAM, or Dutch Guiana.** See GUIANA.

**SURINAM,** a river of Dutch Guiana, which rises in the mountains on the S. frontier, flows through the centre of the colony, and falls into the Atlantic about 10 m. below Paramaribo after a course of about 300 m. It has several tributaries, and is navigable for large vessels about 30 m. from its mouth.

**SURREY,** a S. E. county of England, bordering on Middlesex (from which it is separated by the Thames), Kent, Sussex, Hampshire, and Berkshire; area, 748 sq. m.; pop. in 1871, 1,090,270. That part of the county which lies on the Thames, with much of the land on the borders, is exceedingly fertile. Parts of the shire are famed for the beauty of their scenery. The principal streams are the Wey, Mole, and Wandle, which fall into the Thames. There are extensive market gardens and flower farms, where besides flowers medicinal herbs are raised in large quantities. Numerous canals and railroads intersect the county. Silk, woollen goods, hosiery, paper, earthenware, leather, and ale are manufactured. Besides Southwark, Lambeth, and other portions of London, the most important places are the three county towns, Guildford, Croydon, and Kingston, and Epsom, Reigate, Farnham, and Godalming.

**SURREY, Henry Howard,** earl of, an English poet, born about 1516, beheaded on Tower hill, London, Jan. 21, 1547. He was the eldest son of Thomas Howard, third duke of Norfolk, and passed his youth at the court of Henry VIII. In 1532 he married the daughter of the earl of Oxford, and went to France with the duke of Richmond. He assisted in the trial of Anne Boleyn in 1536, served in France in 1540, and was imprisoned for some wild irregularities in 1543. In 1544 he commanded in France, and earned the rank of field marshal. After the taking of Boulogne he became its governor, and continued the

war with advantage until January, 1546, when he met with a reverse. A panic among his troops caused a failure to intercept a convoy of provisions near St. Étienne, and his rival, the earl of Hertford, afterward the protector Somerset, induced the king to recall him to England. Surrey's comments on this action offended Henry, who imprisoned him for a short time in the tower. The Hertford faction lost no opportunity to excite the fears of the king, and on Dec. 12, 1546, Surrey with his father was again arrested on a charge of treason, for having quartered the royal arms with his own. Surrey in an eloquent defence proved conclusively his right to assume the royal arms; yet he was condemned and executed about a week before the death of the king. His works consist of sonnets, amatory verses, elegies, paraphrases from the Scriptures, and translations of the second and fourth books of the Æneid, and afford the first instance of the use of the sonnet and of blank verse in English poetry. The first edition of his sonnets was published by Richard Tottel in 1557. Editions of his works, with those of Sir Thomas Wyatt, and biographies, have been published by George Frederick Nott, D. D. (2 vols. 4to, 1815–'16; new ed., 1871), Sir Harris Nicolas (1831), Prof. Child (Boston, 1854), and the Rev. R. Gilfillan (Edinburgh, 1856).

**SURROGATE.** See PROBATE.

**SURRY.** **I.** A S. E. county of Virginia, bounded N. E. by James river and S. W. by Blackwater river; area, 340 sq. m.; pop. in 1870, 5,585, of whom 3,192 were colored. The surface is moderately hilly and the soil fertile. The chief productions in 1870 were 85,995 bushels of Indian corn, 44,666 of peas and beans, 15,773 of Irish and 3,381 of sweet potatoes, and 1,104 lbs. of wool. There were 452 horses, 724 milch cows, 1,113 other cattle, 1,032 sheep, and 4,073 swine. Capital, Surry Court House. **II.** A N. W. county of North Carolina, bordering on Virginia, bounded S. by the Yadkin and drained by Ararat and Fisher rivers; area, about 500 sq. m.; pop. in 1870, 11,252, of whom 1,560 were colored. The surface is in part mountainous and generally hilly. Ararat or Pilot mountain in the southeast is the highest peak in this region. The chief productions in 1870 were 26,701 bushels of wheat, 18,029 of rye, 190,171 of Indian corn, 39,321 of oats, 14,707 of Irish and 15,368 of sweet potatoes, 254,286 lbs. of tobacco, 12,690 of wool, 81,238 of butter, 5,183 of flax, 68,658 of honey, and 9,681 gallons of sorghum molasses. There were 1,129 horses, 2,178 milch cows, 3,989 other cattle, 6,414 sheep, and 11,634 swine; 3 manufactories of cotton goods, 5 of chewing tobacco, and 4 flour mills. Capital, Dobson.

**SURVEYING** (Fr. *survoir*, to overlook), the art of measuring portions of the surface of the earth, either for the purpose of calculating the contents of areas, of laying out tracts of required extent, of establishing roads, or of preparing maps. The ancient science of geometry grew out of the practice of surveying, and now embodies the mathematical principles upon which the work is conducted. This science was cultivated by the Egyptians at a very early period, and many of the old Greek writers ascribe its origin to changes which annually took place from the inundation of the Nile, and to the consequent necessity of adjusting the claims of each person respecting the limits of lands. The progress of the art of surveying to its higher application in determining the figure of the earth has been traced in the article EARTH; and the operations in trigonometrical surveys upon a grand scale are described under COAST SURVEY.—The systems of surveying may be classed according to its special objects; as land surveying, for determining the contents of areas, or dividing tracts into lots of smaller dimensions; topographical surveying, which includes the measurement of horizontal lines and angles, and the variations of level, so that the superficial inequalities may be graphically represented; hydrographical or maritime surveying, the object of which is the determination of the positions of channels, shoals, rocks, and the shore line; and mining surveying, for fixing the positions of the underground works in mines, so that these can be correctly mapped. Surveys extending over large territories involve the consideration of the curvature of the earth and the use of spherical trigonometry, and are called geodetic in contradistinction from ordinary surveying over more limited areas, which may with sufficient accuracy be conducted without reference to the figure of the earth, and which may be termed plane surveying. (See GEODESY.) These systems all involve the same principles of measuring lines and angles between definite points upon the area included in the survey, and reproducing these upon paper, reduced to a convenient scale. Calculating the content of the area is commonly the conclusion of the work of land surveying. Tracts of any shape or size may be accurately surveyed, if tolerably level and clear, with no other instrument than the surveyor's chain (see GUNTER, EDMUND); and for this may be substituted a measuring tape, a measured rope, or leather driving reins. This is done by measuring all the sides of the tract, and then diagonals from one corner to another, so selected as to divide the tract into triangles as nearly equilateral as possible. The number of diagonals will be two less than the number of sides. In using the chain it is to be kept as nearly horizontal as possible, or if the measurement is made on a slope the variation from the horizontal is to be determined and duly allowed. In case the corners are not visible from each other, intermediate points may be adopted and used for the terminations of lines from corners, the object being in every case to divide the tract into triangles of which the sides are all measured. Proof lines measured

from a corner of each triangle to the opposite side serve to rectify the other measures of the triangle, and if perpendicular to the side afford a convenient means of calculating upon the ground the area of the triangle. Perpendiculars to any line are readily laid out with a chain, as carpenters and masons draw right angles by what they call the 6, 8, and 10 rule, the popular application of the principle of the square of the hypothenuse being equal to the sum of the squares of the two other sides. The method is to measure from the point where the perpendicular meets the line, either along this line or along the perpendicular, a distance equal to six units of any kind, and then upon the other of these lines a distance of eight units. The two lines are perpendicular to each other when the two termini are just ten units apart. Convenient distances for this measurement might be 3, 4, and 5 rods or chains, or any similar multiples of these numbers, as 21, 28, and 35. Other trigonometrical methods readily suggest themselves. A number of convenient instruments of simple form, known as the surveyor's cross, are in use for setting out perpendiculars by lines of sight, crossing each other at right angles; and a temporary substitute for them is easily made by sticking a pin in each corner of a square piece of board, and sighting across these in the direction of the line and at right angles to it. Angles in the field are determined by a chain, by measuring a "tie line" from a measured point on one side to another measured point on the other side. By this means the boundaries of a tract may be determined when it cannot be conveniently measured off in triangles. A great variety of expedients are adopted for overcoming natural obstacles and determining the extent and shape of inaccessible objects, systems of triangles being in such cases formed outside of and around such objects. Crooked lines are determined by means of perpendicular offsets measured from different points along a straight line run as nearly coincident to the crooked line as may be. In all the methods of surveying, the measurements, together with various incidental observations, are recorded, after some established system, in what are called field notes, and from these the results of the survey are afterward plotted to a convenient scale.—A more common system of surveying is that in which instruments for taking angles are employed in connection with the chain. A graduated horizontal circle, with a straight edge called an alidade turning upon its central point, which may be conveniently sighted along, furnishes the means of ascertaining the angular distance of two lines, the instrument being set at their intersection, and the alidade pointed in the direction of one and then of the other. This involves the principle of the engineer's transit, or of the theodolite. (See Theodolite.) With these instruments angles can be determined with great accuracy, especially when the observations are repeated by reversing the instrument and taking the mean, each including the reading of both verniers. With the transit and the chain for measuring distances, a tract of almost any dimensions is accurately surveyed by measuring the angles at its corners, and the correctness of the work is proved when the sum of all the interior angles is found equal to the product of two right angles, or 180°, by the number of sides of the tract less two; or if the instrument be used by the method called traversing, or "surveying by the back angle" (which consists in noting the angle which each successive line makes, not with the preceding line, but with the first line observed, which is hence called the meridian of the survey), then the reading, on getting round to the last station, and looking back to the first line, should be 360°, or 0°. A compass and chain may be employed in filling up the interior details of a large survey with the transit; and the compass may be used for determining the magnetic bearing of one of the lines, unless this be astronomically ascertained by observations of the north star or of the shadows before and after noon. The compass is the instrument in most common use in ordinary surveying. The magnetic needle, wherever the instrument is set, establishes the meridian line, and from this, the sights of the instrument being turned to any other line, the angle of divergence is read on the graduated circle around the compass box. This instrument has been described under its own name; also the more perfect instrument, in which its inaccuracies are obviated, under the head of Compass, Solar.—The details of surveys are variously modified according to the extent of the area, character of the ground, &c. With the transit or compass, the boundary lines may be all followed out, the angles they make with each other determined, and their lengths measured by the chain; the points of crossing of roads, brooks, fences, &c., measured, and the bearings of these objects taken; and increased accuracy may be given to the work by running diagonal or proof lines, as in chain surveying. Additional checks are furnished by taking at each station the bearings of some marked objects, which when the work is plotted should severally fall at the points of intersection of the lines directed toward these objects from the several stations. Sometimes a tract may be surveyed from a measured base line, either a line within or without it, or one of the boundary lines, by placing the compass successively at each end of this line and taking the bearings of each corner; or without a compass the work may be very conveniently performed with approximate correctness by the plane table method, provided no angles are taken less than 30° nor larger than 150°. A drawing board covered with paper is set up at one end of a measured base line, and a ruler furnished with upright sights at each end, exactly over the drawing edge, is set with this

edge against a fine needle stuck up in the board, and is then directed successively toward the corners of the tract to be surveyed and any other prominent objects, toward which from the needle lines are to be drawn on the paper. One of these lines should also be in the direction of the measured line. The instrument is then taken to the other end of the measured line, the needle is removed along the last line named on the board a distance corresponding, according to the scale adopted, to that of the measured line on the ground, and the board is so placed as to make the line toward the former station correct. The ruler is then again pointed to the same objects, and lines are drawn toward each from the new position of the needle. Their intersections with the former lines designate the places of these objects on the plane. The plane table is used in various other ways, as by moving it from one corner to the next, and placing it at each so that the last line drawn coincides with that in the ground. From any central point also radiating lines may be measured to the corners, and the distances measured and marked off according to the proper scale.—Rivers, brooks, and roads are surveyed by measuring a succession of lines following their general course, and taking offsets from the sides of the line. Streets are followed in a similar manner. Distances are sometimes measured upon roads, where expedition is more important than extreme accuracy, by various substitutes for the chain, some of which, as the odometer and pedometer, have been noticed under the former head. One may soon accustom himself to pace in straight lines, and with steps of uniform lengths, the most exact method being to regulate the natural step, rather than to try to attain one of any determinate length. The usual average step of a man is that of the English military pace, 2½ ft. The French geographical engineers accustom themselves to take regular steps of $\frac{8}{10}$ of a metre, or 2 ft. 7½ in.—The field work being completed, the figure of the tract surveyed is reproduced upon a diminished scale by what is termed plotting; and from this plot the contents are ascertained by a series of mathematical calculations applied successively to the several divisions, or by the method of calculation of latitudes and departures, for which a table of natural sines is required, unless "traverse tables" giving the latitude and departure for any bearing, as furnished in some books on surveying, are at hand. An approximate estimate of the number of acres included in the survey is sometimes made by drawing the plan upon sheet lead of uniform thickness, or upon Bristol board or heavy paper, cutting out the piece on the boundary lines, and weighing it in a delicate balance. The weight may then be compared with that of a similar piece that exactly comprises a definite number of acres, laid out upon the same scale.—The extensive territories of the United States are surveyed upon a peculiar system, planned with reference to the division of the lands into squares of uniform size, so arranged that any tract of 160 acres, or a "quarter section," may have its distinct designation and be readily found upon the map or recognized upon the ground by the marks left by the surveyors. Each great survey is based upon a meridian line run due N. and S. by astronomical measurements the whole extent of the survey in these directions; and upon a "standard parallel" or base line running E. and W., similarly established with great accuracy. Parallels to these lines are run every 6 m., usually with the solar compass corrected by frequent celestial observations; and thus, as nearly as the figure of the earth admits, the surface is divided into squares of 6 m. N. and S. and the same E. and W., each one containing 36 sq. m. or sections, into which the territory is further divided by meridians and parallels run at every mile; while the half mile being marked on these lines by setting what is called a quarter post, the points are established for the subdivision into quarter sections. The squares of 36 sq. m. are termed townships, often contracted to "towns;" and each line of them E. and W. is numbered either N. or S. from the base line, and each line of them N. and S. is termed a range and is numbered E. or W. from the meridian. The N. and S. lines bordering the townships are known as range lines, and the E. and W. as township lines. Each survey is designated by the meridian on which it is based, and of these principal meridians there are 6 designated by numbers and 18 by special names. The following table, compiled from information furnished from the general land office in August, 1875, gives the designation of the meridians, their longitude W. from Greenwich, and the N. latitude or other description of the principal base lines:

| DESIGNATION OF PRINCIPAL MERIDIAN. | Longitude W. fr'm Greenwich. | Principal base lines, N. lat. |
|---|---|---|
| First, boundary bet. Ohio and Indiana.. | 84° 51′ | ........................ |
| Second, through Indiana ............ | 86° 28′ | ........................ |
| Third, through Illinois | 89° 10′ 30″ | ........................ |
| Fourth, N. from mouth of Illinois river .... | 90° 29′ 56″ | 38° 58′ 12″ |
| Fifth, N. from mouth of Arkansas river.. | 90° 58′ | Mouth of St. Francis R. |
| Sixth ............... | 97° 22′ | 40° |
| Michigan............. | 84° 19′ 9″ | 7 m. N. of Detroit. |
| Tallahassee.......... | 84° 18′ | Tallahassee, Fla. |
| St. Stephen.......... | 88° 2′ | 31° |
| Huntsville........... | 86° 31′ | N. boundary of Alabama. |
| Choctaw ............ | 89° 10′ 30″ | 29 m. S. of Jackson, Miss. |
| Washington......... | 91° 5′ | 31° |
| St. Helena, S. from base ............ | 90° 11′ | 31° |
| Louisiana........... | 92° 20′ | 31° |
| New Mexico......... | 106° 52′ 9″ | 34° 19′ |
| Great Salt Lake ..... | 111° 53′ 47″ | 40° 46′ 4″ |
| Boisé............... | 116° 20′ | 43° 26′ |
| Mt. Diablo .......... | 121° 54′ | 37° 53′ |
| San Bernardino...... | 116° 56′ | 34° 6′ |
| Humboldt........... | 124° 11′ | 40° 25′ 30″ |
| Willamette.......... | 122° 44′ | 45° 30′ |
| Montana ........... | 111° 38′ | 45° 46′ 27″ |
| Gila and Salt river.... | 112° 15′ 46″ | 33° 22′ 57″ |
| Indian.............. | 97° 15′ 56″ | 34° 31′ |

The 36 sections of each township are numbered in order, beginning with the N. E. corner and thence proceeding along the N. side of the township to section 6 in the N. W. corner; section 7 begins the next line of sections S., the numbers running E. to 12, and then beginning the third line with 13 and running W. to 18, and so on, bringing No. 36 in the S. E. corner of the township. The quarter sections are designated by their position as N. E., N. W., S. E., and S. W. Fractional sections of irregular shapes are admitted on the borders of lakes, rivers, &c. With these explanations any tract may be readily pointed out upon the government maps from its abbreviated description, or any locality in the wildest territory may be correctly defined; thus the S. W. qr. sect. 13, T. 66 N., R. 34 W., meridian Michigan, is traced directly to an old mining location near the N. E. extremity of Isle Royale, Lake Superior. The law which established this system, while it required that the N. and S. lines should be true meridians, also required that the townships should be six miles square. To satisfy both of these conditions is physically impossible, for the figure of the earth causes the meridians to converge toward the pole, thus making the N. line of each township shorter than its S. line; an inequality which becomes more and more marked the higher the latitude of the surveys. Provision is consequently made for correcting the errors thus caused, by establishing what are called correction lines, which are parallels bounding a line of townships on the north when lying N. of the principal base, or the S. line of townships when lying S. of the principal base, from which the surveys as they are continued are laid out anew, the range lines again starting at correct distances from the principal meridian. In Michigan these correction lines are repeated at the end of every tenth township, but in Oregon they have been repeated with every fifth township. The instructions to the surveyors have been that each range of townships should be made as much over 6 m. in width on each base and correction line as it will fall short of the same width where it closes on to the next correction line N.; and it is further provided that in all cases where the exterior lines of the townships shall exceed or shall not extend 6 m., the excess or deficiency shall be specially noted and added to or deducted from the western or northern sections or half sections in such township, according as the error may be in running the lines from E. to W. or from S. to N. In order to throw the excesses or deficiencies on the N. and on the W. sides of the township, it is necessary to survey the section lines from S. to N. on a true meridian, leaving the result in the N. line of the township to be governed by the convexity of the earth and the convergency of the meridians. Navigable rivers, lakes, and islands are "meandered" or surveyed by the compass and chain along the banks.—The instruments employed on these surveys, besides the solar compass, are a surveying chain 33 ft. long of 50 links, and another of smaller wire as a standard to be used for correcting the former, as often at least as every other day; also 11 tally pins made of steel, telescope, targets, tape measure, and tools for marking the lines upon trees or stones. In surveying through woods, trees intercepted by the line are marked with two chops or notches, one on each side; these are called sight or line trees. Other trees near by not touched by the line are blazed on two sides, quartering toward the line; but if at some distance from the line, the two blazes should be near together, on the side facing the line. These are generally found to be permanent marks, not only recognizable for many years, but carrying with them their own age by the rings of growth around the blaze, which may at any subsequent time be cut out and counted as years; and the same are recognized in courts of law as evidence of the date of the survey. They cannot be obliterated by cutting down the trees or otherwise without leaving evidence of the act. Corners are marked upon trees if found at the right spots, or else upon posts set in the ground, and sometimes a monument of stones is used for a township corner and a single stone for section corners; mounds of earth are made where there are no stones nor timber. At the corners the four adjacent sections are designated by distinct marks cut into a tree, one in each section. These trees facing the corner are plainly marked with the letters B. T. (bearing tree) cut into the wood. Notches cut upon the corner posts or trees indicate the number of miles to the outlines of the township, or, if on the boundaries of the township, to the township corners.—A useful text book is the "Treatise on Land Surveying" of W. M. Gillespie (new ed., New York, 1875).

**SURVILLE, Marguerite Éléonore Clotilde de Vallon-Chalys de,** a French lady of the 15th century, the reputed authoress of remarkable posthumous poems first collected in 1803 by Vanderbourg. They have been ascribed to her descendant, the marquis Joseph Étienne de Surville, a royalist executed in 1798, and with less probability to the publisher Vanderbourg himself. The poems are in the style of the 15th century, and refer to Clotilde's husband Bérenger de Surville, who fell during the defence of Orleans against the English. Other parts of them are believed to apply to the persecutions endured by Louis XVI. The publication has given rise to a long controversy, but even those who, like Villemain and Sainte-Beuve, question its genuineness, unite in praising the genius of the work.

**SUS,** a territory of Morocco, comprising the Atlantic coast of that country between the Atlas mountains and the river Asaka or Nun, and extending E. to the country called Draa; area, about 11,500 sq. m.; pop. estimated at 750,000. It is mostly mountainous, the climate

is healthful, and the soil generally good. The principal productions are the cereals and legumes, and the date, olive, argan, fig, almond, and grape. The mountains are rich in minerals, particularly copper and lead, and there are numerous mines which were anciently worked. The inhabitants, who are Shelloohs or Berbers and Arabs, are more austere and more warlike than others of the Moroccans, and use neither tobacco, liquors, nor coffee. They possess but few cattle or sheep. Tarudant, the chief city, a walled town with five gates, is in the valley of the river Sus, 44 m. from the coast. The N. part of Sus, above the river Gaz, is ruled by the governor of Tarudant under the authority of Morocco. Tazeroualt, S. of the Gaz, is governed by a nominally independent sovereign, and the remainder is under independent sheiks.

**SUSA** (Gr. *τά Σοῦσα*, the city of lilies), an ancient city of Persia, the Shushan (Heb., lily) of the Scriptures, the capital of the province of Susiana, and one of the residences of the court. It was between the Choaspes (the modern Kerkha) and the Coprates (Abzal, an affluent of the Karun), enjoyed a fine climate, and was one of the largest cities of the Persian empire. Strabo says it was 120 stadia in circumference, and surrounded with a wall of burnt brick. According to Pliny, it was founded by Darius Hystaspis, though others make Tithonus, the father of Memnon, its founder. It was for a long period the chief treasury of the Persian empire. In 325 B. C., when visited by Alexander, it possessed immense wealth, and from its plunder he gave largesses to his soldiers and presents of great value to his generals on the occasion of his marriage with Barsine and Parysatis. There has been considerable controversy as to the site of the ancient city, but the discovery by Sir. W. F. Williams and Mr. W. K. Loftus of a gigantic tumulus and cuneiform and Greek inscriptions at the modern Sus, E. of the Kerkha, establish that as the locality of Susa, over Shuster, which was formerly suggested as a probable site.

**SUSIANA** (also *Susis* and *Cissia*), an ancient province or region of Persia, of great extent, mountainous in the northeast, but mostly a plain, lying between the Zagros mountains and the Tigris, bounded N. by Media and S. by the Persian gulf. It nearly corresponded to the modern province of Khuzistan. It was drained by the Pasitigris (supposed to be the lower Karun), the Eulæus (the upper Karun), the Choaspes (Kerkha), the Coprates (Abzal), the Hedypnus (Jerrahi), and the Oroatis (Tab). Its earliest inhabitants were the Elymæi, probably the Elamites of Scripture, a portion of whom still occupied it in the time of Strabo; the other tribes mentioned as settled in the province are the Susii, who were agriculturists and had their villages on the plain, and the Cissii, Cossæi, Uxii, and Messabatæ, all predatory mountaineers. (See ELYMAIS, and KHUZISTAN.)

**SUSO, Heinrich**, a German ascetic writer, also known as Brother Amandus, but whose real name was Von Berg, born in Ueberlingen, on Lake Constance, about 1300, died in Ulm, Jan. 25, 1365. He was educated in a Dominican convent at Constance, and at Cologne under the mystic Eckhart. After his mother's death he adopted her family name in his 18th year, and led a life of penance at the Constance convent till 1340, when he became an itinerant preacher of great influence, especially among women. His anniversary is celebrated by the Dominicans on March 2. Görres, who translated his autobiography, regarded him as among the most fascinating writers of his class, and his *Horologium Sapientiæ Æternæ* (1480) ranked in the middle ages next to the "Imitation of Christ." His works, which were written in Latin, have been often reprinted and translated into several languages (modern German by Diepenbrock, Ratisbon, 1829 and 1838). A new edition of his *Briefe*, by Prega, appeared in 1867.

**SUSQUEHANNA**, a river of New York, Pennsylvania, and Maryland, having its source in Otsego lake, Otsego co., N. Y. It flows generally S. W. to the Pennsylvania line in Broome co., receiving the Unadilla and several smaller tributaries; near the Pennsylvania boundary it flows around the base of a spur of the Alleghanies to Binghamton, forming what is called the "Great Bend;" after receiving the Chenango at Binghamton, its course is W. by S. till it again reaches the Pennsylvania line, where it takes a S. E. direction to Pittston, Luzerne co., receiving the Tioga and numerous small tributaries in its course; at Pittston it turns sharply S. W., passes Wilkesbarre, and receives near Sunbury the large affluent known as the West branch of the Susquehanna, which is more than 200 m. long, rising above Clearfield, and passing that town, Lock Haven, and Williamsport; then turning southward, it receives the Juniata 14 m. above Harrisburg, and flowing thence S. E. enters the Chesapeake bay at Havre de Grace. Its length is a little more than 400 m. from Otsego lake to the bay, and from the junction of the two branches 153 m. The river is generally shallow, and its course much broken by rapids; in the spring, during flood, rafts and strong boats float down from Binghamton, but at other times it is not navigable. Immense quantities of timber are transported upon it. Canals have been constructed along its banks, on the main stream for 125 m., and on the West branch for 124 m. Its waters abound with fish. The lower waters of the Susquehanna are famous for a great abundance of ducks and other wild fowl.

**SUSQUEHANNA**, a N. E. county of Pennsylvania, bordering on New York, and drained by tributaries of the Susquehanna river, a portion of which lies in the N. part of the county; area, 800 sq. m.; pop. in 1870, 37,523. The surface is very hilly, and the soil fertile and

well adapted to grazing. Timber is abundant, and the export trade in pine lumber is very extensive. It is traversed by several railroads. The chief productions in 1870 were 40,522 bushes of wheat, 31,117 of rye, 311,218 of Indian corn, 628,061 of oats, 177,864 of buckwheat, 341,717 of potatoes, 98,459 tons of hay, 108,584 lbs. of wool, 2,580,649 of butter, and 35,560 of honey. There were 8,282 horses, 24,533 milch cows, 20,023 other cattle, 35,700 sheep, and 8,806 swine; 3 manufactories of agricultural implements, 32 of carriages and wagons, 10 of furniture, 4 of iron castings, 18 tanneries, 6 flour mills, 52 saw mills, and 5 woollen mills. Capital, Montrose.

**SUSQUEHANNAS.** See CONESTOGAS.

**SUSSEX. I.** A N. county of New Jersey, bordering on New York and Pennsylvania, bounded N. W. by the Delaware river, and drained by the Flatkill, Paulinskill, Wallkill, and Pequest; area, 600 sq. m.; pop. in 1870, 23,168. The Blue mountains traverse the W. and the Hamburg and Wawayanda mountains the E. part, and the remainder of the surface is very hilly; the soil is very fertile. The Hopatcong lake is in the S. E. part, and supplies the summit level of the Morris canal; and there are several other small lakes. The Sussex railroad passes through it. Franklinite, iron ore, red oxide of zinc, and other minerals are found. The chief productions in 1870 were 64,532 bushels of wheat, 105,306 of rye, 422,776 of Indian corn, 268,477 of oats, 72,870 of buckwheat, 81,006 of potatoes, 40,335 tons of hay, 11,959 lbs. of wool, and 1,455,788 of butter. There were 4,230 horses, 17,376 milch cows, 5,338 other cattle, 3,976 sheep, and 14,414 swine; 8 manufactories of cheese, 1 of pig iron, 3 of castings, 5 of tanned and 5 of curried leather, 18 flour and 7 saw mills, and 6 distilleries. Capital, Newton. **II.** A S. county of Delaware, bordering on Maryland, Delaware bay, and the Atlantic, and drained by affluents of the Nanticoke and Pocomoke rivers and other streams; area, about 1,000 sq. m.; pop. in 1870, 31,696, of whom 5,438 were colored. The surface is almost level, and the soil fertile. It is intersected by the Delaware division of the Philadelphia, Wilmington, and Baltimore railroad, and the Junction and Breakwater railroad. The chief productions in 1870 were 69,239 bushels of wheat, 1,122,693 of Indian corn, 55,779 of oats, 87,300 of Irish and 53,390 of sweet potatoes, 3,161 tons of hay, 25,566 lbs. of tobacco, 185,005 of butter, 23,517 of honey, and 32,347 gallons of sorghum molasses. There were 4,074 horses, 1,265 mules and asses, 6,127 milch cows, 4,250 working oxen, 6,968 other cattle, 12,213 sheep, and 18,409 swine; 1 woollen mill, 5 flour mills, and 20 saw mills. Capital, Georgetown. **III.** A S. E. county of Virginia, bounded N. E. by Blackwater river and intersected by the Nottoway; area, 400 sq. m.; pop. in 1870, 7,885, of whom 4,923 were colored. The surface is hilly and the soil fertile. It is intersected by the Atlantic, Mississippi, and Ohio, and the Richmond, Fredericksburg, and Potomac railroads. The chief productions in 1870 were 118,305 bushels of Indian corn, 21,357 of oats, 7,223 of Irish and 9,818 of sweet potatoes, 16,110 lbs. of tobacco, 1,833 of wool, and 21,528 of butter. There were 546 horses, 876 milch cows, 1,682 other cattle, 1,352 sheep, and 5,731 swine. Capital, Sussex Court House.

**SUSSEX,** a S. E. county of England, bordering on Surrey, Kent, the English channel, and Hampshire; area, 1,464 sq. m.; pop. in 1871, 417,407. The coast line is not much broken, the most remarkable projection being Beachy Head, 564 ft. above the sea. A range of chalk hills, called the North Downs, crosses the N. E. part of the county; and the South Downs, with an average height of 500 ft. and from 4 to 6 m. broad, run through its entire length nearly parallel to the coast. The principal rivers are the Arun, Adur, and Ouse. The county is purely agricultural, and wheat and hops are the chief products. The downs are principally used for pasturage, and are famous for their mutton. Sussex is remarkably rich in antiquities. It is divided into East and West Sussex, and has two county towns, Chichester and Lewes; the other towns of greatest importance are Brighton, Hastings, New Shoreham, Rye, Arundel, and Newhaven.

**SUTHERLAND,** a N. county of Scotland, bordering on the Pentland frith, Caithness, the North sea, Ross-shire, and the Minch; area, 1,886 sq. m.; pop. in 1871, 24,317. Several small islands which lie off the N. and W. coasts are included in the county. On these sides the coasts are generally high and bold, and are indented by numerous arms of the sea; but that on the east is flat with a low sandy beach. The interior is mountainous, the highest summit being 3,280 ft. above the sea. The rivers are all small with short courses, but there are numerous lakes. The principal crops are oats, barley, and potatoes. Sheep farming is extensively carried on. Game, including deer, is abundant. Dornoch, the capital, is the only town. Great improvements were made by the dukes of Sutherland, proprietors of most of the county, aided by parliament.

**SUTHERLAND, George Granville Leveson Gower,** duke of, born Jan. 9, 1758, died July 19, 1833. He was a son of the marquis of Stafford, belonging to a family of historic distinction since the 14th century. He early entered the house of commons, and was ambassador in Paris from 1790 to 1799. In 1799 he was raised to the peerage as Baron Gower. In 1803 he inherited the vast estates of his uncle the duke of Bridgewater and of his father, which added to the Gower domain made him one of the richest men in the world. He extended his uncle's great picture gallery, and promoted the fine arts. He was created a duke Jan. 28, 1833. The Bridgewater estates passed to his second son Francis, afterward earl of Ellesmere, and the other property to the elder son,

George Granville Sutherland Leveson Gower (1786–1861), the second duke. The wife of the latter, Harriet Elizabeth Georgiana (born May 21, 1806, died Oct. 27, 1868), a daughter of the earl of Carlisle, and the queen's mistress of the robes for nearly 20 years, was celebrated for her beauty and accomplishments, and promoted anti-slavery and other philanthropical movements. The present and third duke is Sir George Granville William Sutherland Leveson Gower, born Dec. 19, 1828.

**SUTLEJ,** the most easterly of the five rivers of the Punjaub, in British India. It rises in Thibet N. of the Himalaya mountains, about lat. 31° N., lon. 82° E., flowing N. W. out of Lake Manasarowar, and in the early part of its course is joined by numerous tributaries. After a course of about 200 m. it turns W., and in about lat. 31° 10′, lon. 75° 4′, 550 m. from its source, it unites with the Beas, and the river thence flows S. W. and is called the Ghara until its junction with the Chenaub, 300 m. below, when the united stream takes the name of Punjnud, and joins the Indus after a course of about 50 m., in lat. 28° 58′, lon. 70° 23′. The upper Sutlej is supposed to be the Hesudrus and the lower the Hyphasis of the ancients. In the upper part of its course the Sutlej is an impetuous torrent, and the scenery magnificent. In the Punjaub plain it is from 7 to 30 ft. deep, and from 250 to 500 and 700 yards wide.

**SUTTEE** (Sans. *sati*, from *sat*, pure), properly, a chaste and virtuous wife, but commonly used to designate the self-immolation of a widow by burning herself with the dead body of her husband. The practice has existed for many centuries, not only in India but in other Asiatic countries. Diodorus Siculus gives an instance which occurred in the army of Eumenes more than 300 years B. C., and in India it is certainly of great antiquity, though the period of its origin is unknown. It was more prevalent there than elsewhere, from the belief encouraged by the Brahmans, and professedly derived from their most sacred books, that it conferred the highest merit not only on the widow herself, but on her dead husband. It was asserted by the Brahmanical writers that every woman who thus burned herself should remain in a region of joy with her husband 35,000,000 years, while otherwise she would have no place in paradise. The prevalence of the practice is to be attributed to belief in this view, rather than to any other influence. A careful study of the Vedas and the Institutes of Manu has shown, however, that these works not only do not command suttee, but impliedly prohibit the practice. Certain passages of the Vedas supposed to relate to it have been the subject of animated controversy among Anglo-Indian scholars. The practice prevailed long after the East India company came into power. The Mohammedan emperor Akbar prohibited it in the 16th century, but without much effect. In the first quarter of the present century several unavailing attempts to repress it were made by the company, and in the 12 years between 1815 and 1826 there were 7,154 cases of suttee officially reported in Bengal alone. In 1829 Lord William Bentinck, governor general, enacted a law declaring all aid, assistance, or participation in any act of suttee to be murder, and punishable as such. This measure created much excitement at first in Bengal, the Brahmans denouncing it with great violence as an interference with their religion, and even sending an agent to England with a large sum of money to procure its repeal; but it was rigidly adhered to, and the excitement soon subsided. In 1847, during Lord Hardinge's administration, the prohibitory edict was extended to the native states in subsidiary alliance with the government of India, and the practice is believed now to be extinct.—The mode of performing suttee was much the same throughout India, varying only according to the rank of the parties or the customs of each province. The widow, seating herself by the side of her husband's body, had the sides of her feet painted red, and then bathed herself and dressed in her finest clothes. Meantime a drum was beaten through the adjacent villages. A large company having assembled, a hole was dug in the ground, and a bed formed of green boughs, on which was reared the funeral pile of dry fagots, hemp, clarified butter, and other combustibles. The widow then gave her ornaments to her friends, painted her forehead, tied red cotton round her wrists, put two new combs in her hair, and, when the body of her husband was placed upon the pile, walked around it seven times, scattering parched rice and cowries, and finally ascended the pile, to which she was secured with ropes. The eldest son or the head man of the village usually lighted the pile. In Orissa the pyre was below the level of the ground, and the widow threw herself down upon it. The practice of suttee never prevailed S. of the Kistnah.

**SUTTER,** a central county of California, comprising the delta between the Sacramento and Feather rivers; area, 576 sq. m.; pop. in 1870, 5,030, of whom 208 were Chinese. It consists chiefly of rich bottom lands, almost the only inequality of surface being the Sutter buttes, an isolated group of three peaks in the north. There is little timber. The chief productions in 1870 were 673,749 bushels of wheat, 26,513 of Indian corn, 452,911 of barley, 14,630 gallons of wine, 126,657 lbs. of wool, 117,875 of butter, and 14,100 tons of hay. There were 4,754 horses, 3,623 milch cows, 4,476 other cattle, 35,078 sheep, and 10,690 swine. Capital, Yuba City.

**SUTTER, John Augustus** (originally SUTER), an American pioneer, born at Kandern, Baden, Feb. 15, 1803. He graduated at Bern, Switzerland, as a military officer, and in 1834 emigrated to America, where he became known as a Swiss. At Santa Fé he carried on for

some time a profitable trade with Indians and trappers, whose accounts of California prompted him in 1838 to cross the Rocky mountains; he went to Fort Vancouver and to the Sandwich islands, and thence to Alaska and along the coast of the Pacific, and on July 2, 1839, was stranded in the bay of Yerba Buena (now San Francisco). Penetrating into the interior amid great difficulties, he founded in the same year the earliest white settlement on the site of Sacramento, received a considerable grant of land, and in 1841 built a fort, calling it New Helvetia, which was afterward the first settlement reached by overland emigrants to California. The Mexican authorities appointed him governor of the northern frontier country; and subsequently under the American authorities he was justice of the peace (*alcalde*) and Indian agent. He acquired great influence and wealth, but was ruined in 1848, when gold was first discovered (February) on his property near Coloma, El Dorado co. His laborers deserted him, and his lands were overrun by the gold diggers. He never recovered them, though repeatedly advancing his claims, and has not received any indemnity excepting an annual allowance of $3,000 from the state of California. Since 1873 he has resided at Litiz, Lancaster co., Pa.

**SUTTON, Amos**, an English missionary, born at Sevenoaks, Kent, in 1798, died in Cuttack, India, Aug. 17, 1854. He was ordained as a missionary at Derby in 1824, and sent to Orissa, India, where he labored 30 years, visiting England and America once. He translated the Scriptures into Oriya, compiled an Oriya dictionary, grammar, and lesson book, wrote tracts, and translated many English works. In English he published "The Family Chaplain" (2 vols., Calcutta, 1831–'2), "Narrative of the Mission to Orissa," "Orissa and its Evangelization" (Derby, Eng., and Boston, 1850), "Hymn Book for Mission Congregations," and "Guide to the Saviour."

**SUVAROFF**, properly **Suvoroff, Alexei Vasilievitch**, count, and Prince Italiski, a Russian soldier, born Nov. 24, 1729, died in St. Petersburg, May 17, 1800. He entered the army at a very early age, served in the seven years' war, and commanded with success in Poland against the confederates of Bar (1768–'72), and subsequently against the Turks, the khan of the Crimea, and the Nogai Tartars, obtaining the rank of general-in-chief in 1783. In the campaign of 1787 against the Turks he raised the siege of Kinburn and was wounded, achieved another victory at Fokshani (July 21, 1789) together with the Austrians, and on Sept. 22 routed the main Turkish army on the banks of the Rimnik, for which he received the title of count, and the surname Rimnikski. After repeated repulses he stormed Ismail in 1790, losing 20,000 men, massacred the Turkish garrison of 30,000 troops, and nearly reduced the town to ashes. He was next governor of Yekaterinoslav, Taurida, and the conquered territories on the Dniester. In 1794 he defeated Kosciuszko jointly with Fersen (Oct. 10), and carried Praga, a suburb of Warsaw, by assault (Nov. 3), deluging it with blood. The news of this event he communicated to the empress in the following despatch: "Hurrah! Praga! Suvaroff;" and in reply the empress promoted him in these words: "Bravo! field marshal! Catharine." The caprice of Paul I. drove him from the service in September, 1798; but he was soon reinstated at the request of the emperor Francis of Germany, and in 1799 placed at the head of the united Austrian and Russian armies in Italy. He achieved many brilliant victories over the French, at Cassano, on the Trebbia, and at Novi, for which he was made Prince Italiski. He crossed the Alps to join Korsakoff, at the moment when Masséna's decisive victory over the latter at Zürich (Sept. 25, 1799) entirely changed the military situation, and he was recalled to Russia with the rank of generalissimo. An ovation prepared for him at St. Petersburg was countermanded by a caprice of the czar, and this undeserved mortification gave the death-blow to Suvaroff's shattered health. His autobiography has been published under the title of *Vie de Souvoroff tracée par lui-même, ou collection de ses lettres et de ses écrits*, edited by Glinka (2 vols., Moscow, 1819). One of the best biographies of him is by Polevoi (German ed., Mitau, 1853).

**SUWALKI. I.** A W. government of Poland, bordering on Lomza, Prussia, and the Lithuanian governments of Kovno, Wilna, and Grodno; area, 4,846 sq. m.; pop. in 1870, 524,489. It is level, well wooded, and drained by the Niemen, which constitutes its E. and N. frontier. The principal towns are Suwalki, Augustowo, and Kalvarya. **II.** A town, capital of the government, 150 m. N. E. of Warsaw; pop. in 1867, 16,896, including about 6,000 Jews. It was founded by King Sigismund Augustus, and has been much improved. It contains many brandy distilleries, and the trade is active, especially in horses and cattle during the periodical fairs.

**SUWANNEE**, or **Suwanee**, a N. county of Florida, bounded N., W., and S. W. by the Suwannee river; area, 790 sq. m.; pop. in 1870, 3,556, of whom 1,435 were colored. The surface is undulating, and the soil tolerably fertile. There are two or three small lakes and several swamps. The county is traversed by the Jackson, Pensacola, and Mobile railroad, and its branch from Live Oak to Lawton, Ga. The chief productions in 1870 were 50,934 bushels of Indian corn, 19,404 of oats, 17,670 of sweet potatoes, 10,741 of peas and beans, 511 bales of cotton, 61 hogsheads of sugar, and 17,427 gallons of molasses. There were 1,875 milch cows, 2,156 other cattle, 369 sheep, and 3,946 swine. Capital, Houston.

**SVEABORG**, the principal fortress of Finland, Russia, on the gulf of Finland, in the province and 3 m. S. E. of the town of Helsingfors, the

approaches to which it defends, and under its municipal authority; pop. about 4,000. It is built upon seven granitic islands forming an ellipse, all of them strongly fortified, and connected either by causeways or bridges of boats. The principal fort is on Vargö island, on the south, and comprises a strong castle and barracks, and magazines excavated in the rock. The total number of cannon is 2,000, but it generally mounts 800; and the usual garrison of the fortress varies from 6,000 to 8,000 men, though the casemates have accommodations for 12,000. The harbor within, to which there is but one entrance, has room for 70 ships of the line. The fortress was erected between 1749 and 1758 by Count Ehrenswerd, field marshal of Sweden (who is buried within it), as a defence against Russia. In 1808 it was besieged by the Russians, and after two months the Swedish commandant and admiral Cronstedt, though amply supplied with the means of defence, capitulated (April 7). Left in the possession of the conquerors by the peace of Sept. 17, 1809, it was called the "Gibraltar of the North," and has since been regarded as the strongest fortress of Russia on the Baltic. In August, 1855, it was severely but unsuccessfully bombarded by the allied fleet.

**SVERTCHKOFF, Nikolai,** a Russian artist, born in St. Petersburg in 1818. He spent several years in Paris, and in 1852 became a member of the academy of St. Petersburg, and in 1855 a professor there. He excels in painting horses, costumes, and figures, and also as a sculptor. His principal works include "The Czar Alexander reviewing his Troops," "A Russian Team of three Horses," "A Russian Horse Market," and "A Relay of Post Horses."

**SWABIA, or Suabia** (Ger. *Schwaben*), a duchy of the German empire during its earlier period, and subsequently one of its ten great circles or divisions. The circle was bounded N. by the Palatinate of the Rhine and Franconia, E. by Bavaria, S. by Switzerland, and W. by France, the Rhine flowing on the borders of the two latter. It had an area of 13,000 sq. m., and was conterminous with the present kingdom of Würtemberg, the S. part of Baden, and the district of Swabia and Neuburg in Bavaria. It is one of the most beautiful and fertile tracts in Germany, and is traversed by the Danube from S. W. to N. E., and diversified by the mountain scenery of the Black Forest on the west and the Alps on the south. It was originally called Alemannia, and received the name of Swabia (from the Suevi, who inhabited parts of it) when the Alemanni were conquered by Clovis in 496. St. Columbanus introduced Christianity in the 7th century. Toward the end of the 11th century it was in a very flourishing condition, and in 1080 the emperor Henry IV. made the duchy of Swabia hereditary in the family of Frederick of Hohenstaufen. It subsequently became one of the most powerful and most civilized countries of Germany. In the Italian wars the reigning house of Swabia stood at the head of the Ghibelline party, and when Conradin was executed at Naples in 1268 the line became extinct. (See HOHENSTAUFEN.) The various cities, prelates, and counts then made themselves independent, and since that time Swabia has not formed a separate state. Various confederacies, however, were formed at different periods, known in history under the name of Swabian leagues. The principal of these was the "great Swabian league" of 1488. The Swabian circle was definitely organized in 1563.

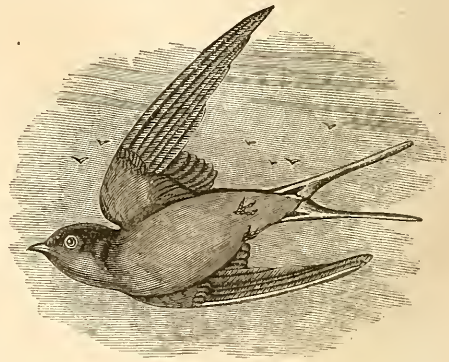
**SWAIN,** a S. W. county of North Carolina, separated from Tennessee on the north by the Great Smoky mountains; area, about 500 sq. m. It has been formed since the census of 1870 from Jackson co. The surface is generally elevated and mountainous; the soil is good and the county well adapted to stock raising. Capital, Charleston.

**SWAIN, Charles,** an English poet, born in Manchester in 1803, died near there, Sept. 22, 1874. He learned the business of dyeing, but at the age of 30 became an engraver. In 1828 he published "Metrical Essays," followed by "Beauties of the Mind" (1831) and "Dryburgh Abbey" (1832), an elegy on Sir Walter Scott. His subsequent publications comprise "A Memoir of Henry Liversedge" (1835); "Rhymes for Childhood" (1846); "Dramatic Chapters, Poems, and Songs" (1847); "English Melodies" (1849); "Letters from Laura d'Auverne" (1853); and "Art and Fashion" (1863). Swain was known as the "Manchester poet." A collection of his poems has appeared in the United States (Boston, 1858; new ed., 1872).

**SWAINSON, William,** an English naturalist, born in Liverpool, Oct. 8, 1789. He served in the Mediterranean in the army commissariat department from 1807 to 1815, then travelled in South America with Koster, the German naturalist, and on his return settled in London. In 1820 he commenced the publication of "Zoölogical Illustrations, or original Figures and Descriptions of new, rare, or interesting Animals," since republished in 6 vols. 8vo; and in 1821 of "Exotic Conchology" (4to; new ed., edited by S. Hawley, 1841). He has also produced a "Naturalist's Guide for collecting and preserving all Subjects of Natural History and Botany," &c. (1822); 12 volumes on natural history in Lardner's "Cabinet Cyclopædia;" two volumes on the "Birds of Western Africa" and one on the "Fly Catchers," in Jardine's "Naturalist's Library" (1837–'8); "A Treatise on Malacology, or the Natural Classification of Shells and Shell Fish" (1840); and a series of "Ornithological Drawings," being selections of Brazilian and Mexican birds (1834–'41). He assisted Sir John Richardson in the preparation of that part of his "Fauna Boreali-Americana" which relates to North American birds, and in connection with Mr. Shuckard prepared in 1840 "The History and Natural Arrangement of Insects." In 1841 he emigrated to New Zealand, and since his residence there he has published several works on

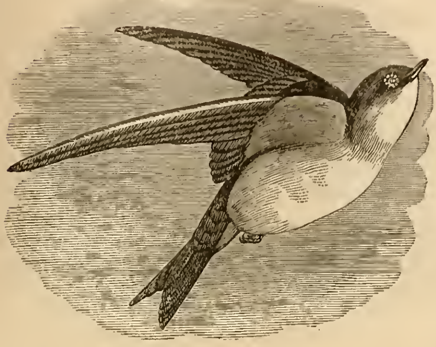
its social and political condition, and on the natural history of that colony and Tasmania.

**SWALLOW**, the general name of the diurnal fissirostral birds of the family *hirundinidæ*, not including the swifts, many of which are called swallows. (See SWIFT.) The bill is short and weak, very broad at the base and suddenly compressed to the tip; the wings long, narrow, and acute; primaries nine or ten, the first the longest; tail more or less forked; tarsi very short and weak, generally naked, and covered with scales; toes usually long and slender, with the claws moderate, curved, and sharp; the gape very wide and usually provided with short bristles. The typical genus *hirundo* (Linn.), having more than 50 species, embraces several well known, elegant swallows both in America and the old world, remarkable for their great powers of flight. Their food consists of insects, which they take on the wing, usually in the neighborhood of water, with remarkable skill and grace; they drink on the wing, sweeping along the surface of the water, and often wash themselves by a sudden plunge. They fly at the rate of a mile a minute in their ordinary evolutions, but are rather awkward on the ground from the length of the wings and the shortness of the legs; they live more on the wing than any other birds, even feeding their young in the air; their sight is very acute; they fly low in damp weather, where the insects are most abundant, and are thence supposed to foretell rain. They are most numerous in the tropics, migrating to and from temperate regions; in Great Britain they make their appearance from Africa, where they spend the winter, from the beginning to the middle of April, and depart toward the end of October, crossing the channel singly or in small parties; they often alight on vessels, and sometimes fall into the sea. In the United States they arrive about a month later and depart several weeks earlier. Most species prefer the neighborhood of man, building their nests in society in his dwellings and buildings; they form attachments to places, returning year after year to the same nests; they are docile and have been partially domesticated; a single bird probably collects about 1,000 insects in the course of a day. The nests are generally made of clay or mud mixed with straw and grass, of various forms, and attached externally to some building; many species breed in holes in sand banks, at the end of which is the nest of grasses and feathers; the eggs are five or six.—The best known species in the old world is the chimney or house swallow (*H. rustica*, Linn.); it is 6½ in. long, bluish black above, with a band on the chest, and the forehead, eyebrows, and throat, ruddy; lower parts rufous white, with a white spot on the inner web of each tail feather except the two innermost; the tail is very long and forked. As its name imports, it frequently builds its nest in chimneys a few feet from the top; it also nests in old walls and shafts of mines, and among the rafters of barns and sheds; the nest is cup-shaped, made of earth and straw and lined with feathers; the eggs are white, spotted with ash and red. The parents are very attentive to the young, and brave in their defence; they have two broods in a season, the second sometimes left to perish, not being able to quit the nest at the period of migration; the males are sweet singers, and very courageous. The analogue of this species in America is not the one commonly called chimney swallow with us (which is a swift), but the barn swallow (*H. horreorum*, Barton); it is about 7 in. long and 13 in. in alar extent, glossy steel-blue above, with concealed white in middle of back; it much resembles its European congener, though it has the pectoral collar interrupted in the middle, while in *H. rustica* it continues across. It inhabits North America from the Atlantic to the Pacific, appearing in the southern states from the middle of February to March 1, a few at a time, reaching New England in mild seasons by the middle of May. It is gentle and easily tamed. The nest is made of mud or moist earth mixed with grasses, and is attached to the beams and rafters of barns and outbuildings; it is generally about 8 in. long, 6 in. in the greatest diameter, and from beam to outside of shell 6½ to 4 in., weighing often more than 2 lbs.; the eggs are four to six, small and long, white with a few spots of reddish brown; incubation lasts 13 days, both sexes assisting, and both occupying the nest at night until the young are hatched. This species collects in large flocks in midsummer on barns and sheds, telegraph wires, &c., chirping almost continually, and making short sallies in search of insects. They start for the south by the end of August or first of September, early on some fair morning; they do not fly high, and follow the shore or the course of rivers.—The cliff or fulvous swallow (*H.* [*petrochelidon*] *lunifrons*, Say) is about 5 in. long and 12½ in. in alar extent; the crown and back are steel-blue, separated more or less broadly by a grayish collar; the chin, throat, and sides of head dark chestnut; breast grayish brown;



Barn Swallow (Hirundo horreorum).

belly white; steel-blue spot on throat; rump light chestnut, and forehead brownish white; tail slightly notched. It is found throughout North America from ocean to ocean; it



White-bellied Swallow (Hirundo bicolor).

is called republican swallow by Audubon, in allusion to the habit of associating to make their nests and rear the young. The nest is built under eaves and cornices, where it is partly sheltered from the rain; it is made of clay and sand, the entrance near the top, shaped like an earthen retort with the neck broken off; it is lined with straw and grass; the eggs are white with dusky spots; the nest is bravely defended by the parents. The white-bellied swallow or American house martin (*H. bicolor*, Vieill.) is $6\frac{1}{4}$ in. long and $12\frac{1}{2}$ in. in alar extent, of a glossy metallic green above and white below; it comes earlier in the spring than the others, but is not so common; the nest is made in a hollow tree, lined with

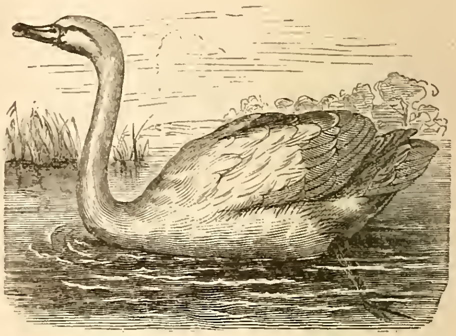
Sand Swallow (Cotyle riparia).

grass and feathers, and the eggs are white with a bluish tinge; it is as widely distributed as the others in North America, and some time before migrating southward gets very fat on myrtle berries (*myrica cerifera*). For the largest of the American swallows, see MARTIN.—The bank, sand, or river swallow belongs to the genus *cotyle* (Boie); it is the *C. riparia* (Boie), and the smallest of the American species, being $4\frac{3}{4}$ in. long and $10\frac{1}{2}$ in. in alar extent. The bill is very flat, and extremely wide at base, gradually narrowing toward the tip; nostrils prominent and rounded; tail moderate, nearly even or very slightly forked; tarsi rather long, with a tuft of feathers near the toes behind. It is grayish brown above, sometimes approaching sooty, with paler margins; below pure white, with a band across the breast and sides like the back. It is generally distributed over America and Europe, wherever there is a sandy pit or river bank; it is the earliest to arrive in the spring, and less familiar than the other species; it hollows out a tubular gallery in the sand banks, often more than 3 ft. in length, at the end of which is a larger excavation for the nest; it is called sand or bank martin in Europe. There is no appreciable difference between the European and American birds.

**SWAMMERDAM, Johannes,** a Dutch entomologist, born in Amsterdam in 1637, died about 1680. He studied medicine with his father and at the university of Leyden. He gave considerable attention to the natural history of insects, and made many dissections and microscopical examinations and a large collection of specimens. He obtained leave at Amsterdam to dissect the bodies of those who died in the hospital, and invented the mode for the preparation of hollow organs now usually employed in anatomy. He published a "General History of Insects" (1669), "The Natural History of Bees" (1673), a "History of the Ephemeras" (1675), and other works. His entomological collection was divided at his death and sold in small portions. Boerhaave edited his works and wrote his life. An English translation of his entomological works by T. Floyd was published in 1758.

**SWAN,** a web-footed bird of the duck family, and the type of the subfamily *cygninæ*, embracing some of the largest and most graceful of aquatic birds. The bill and feet are much like those of the ducks, the former being stout, of nearly equal width throughout, and with a comparatively small nail; the neck very long, and the legs short; wings long and powerful, second and third quills equal and longest; tail short and rounded; eyes small and near the bill. They perform long migrations, flying in single files uniting at an acute angle; the diet consists of grass, roots, and seeds, in search of which they submerge the head only, keeping it under water three to five minutes at a time; they also devour aquatic worms and insects, young frogs, and probably small fish; the intestines are long, as in the vegetable feeders; they are gregarious at all seasons, awkward on land, but rapid and high fliers; they are remarkably careful to keep their plumage, which

is generally white, free from dirt. The nest is bulky, of grass and coarse materials, placed on the ground among the rushes and near the water; it is sometimes raised a foot or more to avoid inundations; the male guards the nest, assists the female in the care of the young, and boldly defends them even against predaceous animals and man; the eggs are five to eight, and incubation lasts six weeks.—In the typical genus *cygnus* (Linn.) the bill is longer than the head, the base covered by a soft skin extending to the anterior half of the eyes, and the nostrils in the middle portion; lower part of tibia bare; tarsus much shorter than the foot, compressed and scaly; webs full; hind toe small, much elevated, with a narrow lobe; tail of 20 to 24 feathers, rounded or wedge-shaped; sexes similarly colored, but the females the smaller. Wagler has divided the old genus *cygnus* into two, *cygnus* and *olor*, according as there is or is not a swollen fleshy tubercle at the base of the bill; in the former also the lamellæ of the edges of the bill are visibly projecting, and in the latter not; in the former belongs the tame swan of Europe, and in the latter the wild swan and both of the North American species. The European wild or whooping swan (*C. ferus*, Ray) is $4\frac{1}{2}$ to $4\frac{3}{4}$ ft. long, white, with the head and neck tinged with yellowish, and a black bill, yellowish at the base and without tubercle; it is a winter visitor in Great Britain, migrating northward in the spring to Lapland, Russia, Siberia, &c., where it breeds; the young are brownish gray. The male has a peculiar note resembling the word "hoop," repeated several times in succession, the intensity greatly increased by the convolutions of the windpipe, which, after penetrating the keel of the breast bone to its posterior portion, is bent forward again to the front of this bone before going to the lungs; this peculiarity is not found in the tame swan, which has a soft and plaintive voice. The swan is cruel and vindictive; the males fight savagely at pairing time, and the female with young attacks everything which approaches her nest; it can repel any bird, even the eagle, and in fighting the combatants try to drown one another by holding the rival's head under water, often with success. Though heavy fliers, they rise to a great height, uttering a loud, harsh, and trumpet-like note when sailing high in the air; when enraged or alarmed they can swim faster than a man can walk. This bird was sacred to Apollo, and was the bird of the Muses; it was fabulously celebrated for its melodious song, especially at the time of its death. The flesh is dark and tough. The European tame swan (*C. olor*, Gmel.) has a red bill, with black tip and sides, and a tubercle at the base; the trachea has no convolutions. It is generally distributed over Europe and America as an ornamental bird; it is large and handsome, a permanent resident in temperate Europe; in Great Britain from remote periods it has been protected by preservative laws; the male is called a cob and the female a pen; its life is said to extend to a century. The young have a gray plumage and a lead-colored bill. The flesh is said to have a flavor between that of the goose and the hare. The most prized are brought to the United States from Hamburg, and are generally what are called Polish swans (*C. immutabilis*, Yarr.), from the Baltic shores, noted for having white cygnets.—The American or whistling swan (*C. Americanus*, Sharpless) is 55 in. long and about 7 ft. in alar extent, with a bill of $4\frac{1}{2}$ in.; the bill is as long as the head, high at the base, the feathers on the forehead ending in a semicircular outline; the nostrils far forward; tail of 20 feathers; the adult is pure white with bill and legs black, and an orange or yellowish spot in front of the eye; young birds are brownish, especially on the head; they are five or six years in coming to maturity. This species is spread over the North American continent from the Atlantic to the Pacific; many are shot in winter and spring on the coasts of Virginia, Maryland, and Delaware; when they are feeding, one always acts as sentinel; they fly in an angle, each line in single file, the leading bird as he gets weary retiring to the rear. The nest is described as made of moss, peat, and sticks, 5 to 6 ft. long, $4\frac{3}{4}$ ft. wide, and 2 ft. high, with the cavity $1\frac{1}{2}$ ft. in diameter; the eggs are brownish white, clouded with darker. The trumpeter swan (*C. buccinator*, Rich.) is about 5 ft. long and 7 ft. in alar extent, with the bill $4\frac{1}{2}$ in.; bill longer than the head, the feathers on the forehead with a semi-elliptical outline; nostrils with the anterior extremity only as far forward as the middle of the commissure; tail with 24 feathers; the adults are pure white, the legs and bill entirely black, the latter without any red spot at base. It is found from the Mississippi valley to the Pacific, appearing on the lower Ohio about the end of October, and going south when the ice gets thick; it is very common in the fur countries, breeding as far north as lat. 61° N. The note is more sonorous than in the whistling swan; it is not so wary as the last named species;



European Tame Swan (Cygnus olor).

it is the principal source of the fine down so much prized for muffs and tippets.—A black swan, once considered as apocryphal as a white crow, inhabits Australia. The *chenopis atrata* (Wagl.), of that continent and Tasmania, is black except a few white primaries and a bright red bill; it is nearly as large as the common swan, and is now not unfrequently seen with it in the parks of Europe and the United States.

**SWAN RIVER.** See Western Australia.

**SWANSEA** (Welsh, *Abertawy*), a town of Glamorganshire, Wales, on the W. bank of the river Tawy, where it falls into the bay of Swansea, Bristol channel, 60 m. W. N. W. of Bristol; pop. in 1871, 51,702. It is much resorted to for sea bathing. There are extensive anthracite mines in the neighborhood, which, together with the convenience of the port, have made it the principal seat of the copper trade of Great Britain. Copper ore is brought hither for smelting from Cuba, North and South America, Australia, &c. There are also iron, tin plate, and zinc works, potteries, and ship yards. The port was entered in 1873 by 6,835 British vessels, tonnage 877,241, and 1,165 foreign vessels, tonnage 197,062. There were cleared 6,612 vessels, tonnage 859,619, of which 1,258 were foreign, tonnage 216,527. The exports in the same year were valued at £1,855,712. The exports of coal in the year ending with February, 1875, were 30,592 tons, and the coastwise shipments 17,874 tons. There are extensive docks; the first floating dock was built at Swansea in 1852. Large vessels can come close to the town at flood, but at ebb the harbor is nearly dry.

**SWEATING SICKNESS,** a disease which often prevailed extensively in Europe and Asia during the middle ages, and which still frequently appears in Turkey and other parts of Europe and Asia. The older descriptions of it are somewhat vague, but from the general symptoms it is doubtless the disease which has been accurately described by Rayer and others, and is now called miliary fever, sudatoria, and miliaria, and is defined as "an eruption of innumerable minute pimples with white summits, occurring in successive crops upon the skin of the trunk and extremities, preceded and accompanied with fever, oppression of respiration, and copious sweats of a rank, sour, fetid odor, peculiar to the disease. The base of the pimples and the skin around are red and irritable." Pathologists are not agreed as to its specific nature; some deny that a peculiar specific disease exists, as in smallpox or scarlatina. The fever which precedes the eruption is ushered in by intense chills, oppression of breathing, fainting, and pains in the head, loins, and limbs. In a few hours nausea and profuse sweating come on, but without relieving the other symptoms. The pulse is small and rapid, often hard and irregular. The tongue is coated with a foul yellow fur, and the bowels are constipated. From the 5th or 6th day to the 21st an itching sensation is felt in the mammary and epigastric regions and the inner surface of the arms, and the skin of those parts becomes red and rough, with numerous elevations about the size of common pin heads. In a short time the summits of these elevations become pearly white, the cuticle being elevated by a slightly opaque, sero-albuminous fluid. Several crops of elevations break out in succession for from three to seven days, followed by desquamation of the cuticle. In severe cases the eruption appears at the junction of the skin and mucous membrane, and is liable to become aphthous. Two forms are recognized, the mild and the malignant, the latter being accompanied by violent inflammation of some internal organ, and proving fatal sometimes in two or three days. The treatment consists in cooling drinks, bland diet, and frequent laving and sponging of the cutaneous surface.—The disease appeared in England in 1485, just after the battle of Bosworth, and disappeared suddenly at the beginning of the next year. It attacked people chiefly in the prime of life, and scarcely one per cent. recovered. It appeared again in the summer of 1506, bnt in a mild form. In July, 1517, it appeared in a very malignant form, sometimes terminating fatally in a few hours. It lasted for six months, and like the preceding epidemics was confined to England. In May, 1528, it again appeared in London. It lingered in the city till the next year, and was so fatal as to receive the name of "the great mortality." It finally extended over the northern half of the continent, and 2,000 persons fell victims to it in 21 days at Hamburg. In 1551 it made its last appearance in England, and continued six months.

**SWEDBERG, Jesper,** a Swedish clergyman, father of Emanuel Swedenborg, born at Fahlun, Aug. 28, 1653, died at Brunsbo, July 26, 1735. His father was a copper smelter named Daniel Isaksson. Swedberg took his name from a small family estate. He was educated at Upsal, and in 1685 was ordained a priest and appointed chaplain to the king's regiment of cavalry life guards. In 1690 he was made pastor of Vingaker, in 1692 professor of theology at Upsal, and soon after rector of the university. In 1691 he was one of a commission to revise the Swedish Bible, which work was completed in a year. In 1694 he published a psalm book, which was suppressed as pietistic. In 1702 Charles XII. made him bishop of Skara in West Gothland, in which office he remained till his death. In 1722 he produced the first Swedish grammar ever printed. About 1732 the Swedish congregations in London, Lisbon, and North America elected him their bishop.

**SWEDEN** (Swedish, *Sverige*), a kingdom of northern Europe, forming with Norway the Scandinavian peninsula, and lying between lat. 55° 20′ and 69° N., and lon. 11° 10′ and 24° 10′ E. It is bounded N. and W. by Norway, S. W. by the Skager Rack, the Cattegat, and the Sound, S. by the Baltic sea, E. by the Baltic

and the gulf of Bothnia, and N. E. by Finland. It is separated from Norway by the main chain of the Scandinavian system of mountains, along which a broad avenue cut in the forest, and having at certain intervals stone monuments, marks the line of division. This avenue is maintained with great care by the Norwegians, and its condition regularly reported to their *storthing* or legislature. The extreme length of Sweden is 970 m., and its general breadth about 200 m.—The coast line, about 1,400 m. in extent, is deeply indented by numerous *fiords* or gulfs. About 300 m. of the coast borders on the Skager Rack, Cattegat, and Sound; the remainder is washed by the Baltic and the gulf of Bothnia. The W. shore along the Skager Rack and Cattegat is rocky, but seldom elevated more than 30 or 40 ft. The S. shore as far as Sölvesborg in Blekinge is low and sandy; thence northward it is, with some exceptions, lined by precipitous cliffs about 50 ft. high as far as Calmar sound. Along the Sound the coast is again low and sandy, but N. of it rises into higher cliffs, and at the outlet of Lake Mælar presents bold headlands 100 ft. high. N. of the mouth of the Dal and as far as the strait of Quarken rocky and sandy shores alternate; and the upper part of the gulf of Bothnia is characterized by low sandy beaches. The entire coast N. of Calmar is lined with numerous rocky and sandy islets, which render access difficult in many places. Off of the län of Calmar, and separated from it by Calmar sound, is the island of Öland; and N. E. of this lies Gottland, the largest island of Sweden. The Aland group, off the län of Stockholm, belongs to Russia.—The mountain chain which forms the spine of the Scandinavian peninsula has a much larger portion of its most elevated surface in Norway than in Sweden. Its southern part, the Langfield chain, is wholly in Norway, while the Dovrefield and Kiölen chains form the boundary between the two countries, Sulitelma in lat. 67° and Sylfjell in lat. 63°, lie partly in each. The Norwegian side of these mountains is much more precipitous than the Swedish. In Sweden they form a plateau nearly 4,000 ft. high, from which occasional peaks rise to a greater height, but which in a breadth of 40 m. slopes gradually to an elevation of from 800 to 1,000 ft., and thence declines in hills of moderate elevation to the sea shore. S. of lat. 59° the country is very level, and the great plain of Scania, the most fertile tract of the peninsula, occupies a considerable portion of the southern extremity. The northern part of Sweden is rocky, with bleak, barren, snow-clad hills, and a stunted vegetation of birch, fir, and small pines, in the higher lands intermingled with dreary lakes and swamps. The great forest region lies S. of lat. 64°, where the surface is less elevated. Further S. it is more level, and the woods give place to cultivated fields.—Sweden abounds in beautiful lakes, which cover more than 14,000 sq. m. of its surface. Lake Wener has an area of about 2,000 sq. m., and, excepting Ladoga and Onega in Russia, is the largest lake in Europe. Its principal affluent is the Klar, which enters it from the north, and its waters are carried into the Cattegat by the Götha. At the Trolhätta falls on the latter, the river descends by rapids 108 ft. in 5 m. Lake Wetter is 80 m. long and has an area of 715 sq. m. Its surface is about 300 ft. above the sea, and in one part it is more than 400 ft. deep. It has many small affluents. The river Motala carries its waters through several smaller lakes into the Baltic. The Mælar lake, about 75 m. long, is a series of lakes connected by channels and having many branches. It contains more than 1,200 islands, most of which are of great beauty. Other principal lakes are Hjelmar, connected with the Mælar, Siljan, Stor, Stor Uman, Horn Afvan, Stora Lulea, and Tornea, almost all in the north. None of the rivers of Sweden are navigable, excepting those which have been rendered so artificially. With the exception of the Klar and a few smaller streams on the W. coast and on the coast of the Baltic, nearly all of them have their source in the main mountain range and flow S. E. into the gulf of Bothnia. The largest is the Dal, which is formed by the junction near Fahlun of the East Dal and the West Dal, and enters the gulf of Bothnia near Gefle. At Elfkarleby, near its mouth, it forms a splendid cascade, which is surrounded by fine scenery. N. of this the principal rivers are the Ljusne, Indals, Angerman, Umea and its branch the Windel, Skelleftea, Pitea, Lulea, Ranea, Kalix, and Tornea. The last, with its branch the Muonio, forms the boundary line between Sweden and Russia. Most of these rivers have cataracts and rapids. The Angerman is 240 m. long, and is navigable for vessels of 600 tons 60 m. from its mouth.—The geological formations of Sweden are chiefly granites, gneiss, and metamorphic rocks. They compose most of the Scandinavian chain of mountains, and are in many places covered with Silurian strata, which sometimes are seen undisturbed from their original horizontal position. These are broken through and overflowed by trap; and the surface is generally covered with the drift formation and large bowlders. The metamorphic group abounds in metallic veins, which constitute a large portion of the wealth of the country. Among the metals produced are iron, copper, lead, zinc, silver, gold, nickel, cobalt, and manganese. The pyritiferous slates are largely worked for alum and copperas, and these, as well as the sulphurous gangues of the various ores, furnish unlimited supplies of sulphur. In 1872 there were produced 4,881 cwt. of alum, 1,914 cwt. of iron vitriol, 2,936 cwt. of copper vitriol, and 7,667 cwt. of sulphur. The most important iron mines are those at Dannemora and Osterby in the län of Upsal, Presberg in Wermland, Taberg in Jönköping, and in the läns of Örebro, Gefleborg,

SWEDEN,
NORWAY,
AND
DENMARK.
English Miles
20 40 60 80 100 200
Longitude East from Washington
79° 81° 83° 85° 87° 89° 91° 93° 95° 97° 99° 101° 103° 105° 107° 109° 111°
70° 68° 66° 64°
NORTH SEA
LOFFODEN ISLANDS
West Fiord
North Cape
Magero
Hammerfest
Tromsö
Vardsö
Vardöhuus
Kola
White Sea
Arctic Circle
Norrbotten
Westerbotten
WesterNorrland
N. Drontheim
Christiansund
Luleå
Piteå
Umeå
Torneå
Haparanda
Quarken
Vasa
Tornea R.
Muonio R.
Lainio R.
Kalix R.
Lina R.
Rane R.
Stora Lulea
Pitea R.
Byske R.
Skellefte R.
Vindel R.
Umea R.
Lögde R.
Gröde R.
Tana R.
Alten R.
Pasvik R.
Kemi R.
Enontekis
Bodö
Salten F.
Senjen
Senjen F.
Andö
Langö
E. Vaagö
W. Vaagö
Moskenes
Malström
Varö
Donnaesö
Vegen
Vigten Is.
Folden Fd.
Björnör
Fröyen
Hitteren
Smölen
Sörö
Kvalö
Ringvatsö
Porsanger F.
Laxe F.
Tana F.
Nord Kyn
Varanger Fd.


GULF OF FINLAND
GULF OF BOTHNIA
GULF OF RIGA
BALTIC SEA
SKAGER RACK
CATTEGAT
Gulf of Dantzic
SVEALAND
GOTLAND
DENMARK
PRUSSIA
Mecklenburg
HOLSTEIN
SCHLESWIG
LÜBECK
ST. PETERSBURG
Viborg
Helsingfors
Åbo
Björneborg
Riga
L. Peipus
Dagö
Ösel
Gottland
Wisby
Gottska Sanda
Åland Is.
STOCKHOLM
Upsala
Gefle
Hudikswall
Sundsvall
Söderhamn
Kopparberg
Falun
Werinland
Carlstad
Örebro
Westmanland
Södermanland
Nyköping
Norrköping
Linköping
Östergötland
Jönköping
Skaraborg
Elfsborg
Göteborg
GOTHENBURG
Halland
Halmstad
Kronoberg
Wexiö
Calmar
Öland
Borgholm
Blekinge
Carlskrona
Carlshamn
Christianstad
Malmöhus
Malmö
Lund
Ystad
Helsingborg
Landskrona
Bornholm
Rönne
COPENHAGEN
Elsinore
Fünen
Seeland
Rügen
Fehmarn
Falster
Möen
Kiel
Flensborg
Schleswig
Heligoland
R. Elbe
R. Weser
Dantzic
R. Vistula
Aalborg
Aarhus
Viborg
Randers
Horsens
Ribe
Ringkjöbing
Skagen
The Skaw
Hjörring
Frederikshavn
Läsö
Anholt
Christiania
Agershus
Hedemarken
Christian
Buskerud
Bratsberg
Nedenaes
Lister
Stavanger
Bergen
N. Bergenhus
Christiansand
The Naze
Arendal
Kongsberg
Drammen
Lillehammer
Hamar
Miosen L.
Wener L.
Wetter L.
Mariestad
Silian
ICELAND
(on the same Scale)
Reykjavik
Faxafiord
Breidifiord
Isafjardardjup
Hunaflói
Skagafiord
Eyjafiord
Skjalfandi
Akureyri
Heklu
Thingvalla
Vatna Jokull
Klofa Jokull
Longitude East from Washington
Longitude West from Greenwich
16° Longitude East 18° from Greenwich 20°
8° 10° 12° 14° 22° 24° 26° 28°
54° 56° 58° 60°

SWEDEN, NORWAY, AND DENMARK.
English Miles
Longitude East from Washington
Longitude East from Greenwich
NORTH SEA
GULF OF BOTHNIA
BALTIC SEA
GULF OF FINLAND
Gulf of Riga
SKAGER RACK
CATTEGAT
RUSSIA
PRUSSIA
LOFFODEN ISLANDS
North Cape
Arctic Circle
White Sea
STOCKHOLM
CHRISTIANIA
COPENHAGEN
ICELAND (on the same Scale)

Kopparberg, and Westmanland. Taberg is a mountain of magnetic ore 1,129 ft. high. At Gellwara, near the Lulea river, in Norrbotten, is also a mountain of nearly pure magnetic iron ore, with some specular ore. Swedish iron is not excelled by any in the world, and is largely used in the manufacture of steel. Nearly 500 iron mines were open in 1873; the total yield of rock iron ore was 18,170,000 cwt., and of bog iron ore 117,793 cwt. The principal copper mines are at Fahlun in Kopparberg, at Atvidaberg in Ostergottland, at Flögforss in Örebro, in Jämtland, and in Westmanland. Silver is mined in small quantities at Sala in Westmanland and in Örebro, and zinc near Askersund in Örebro and other places. In 1873 the yield of copper was about 5,000 cwt., of silver 16 cwt., of zinc 602,883 cwt., of nickel 24,420 cwt., and of manganese 6,713 cwt. Coal of inferior quality is found near Helsingborg in Malmö, and large veins of better quality have been discovered lately in other parts. The yield in 1873 was 2,406,486 cubic feet. Marble is quarried in Ostergottland, and at Elfdal in Kopparberg are the celebrated porphyry quarries, where many varieties of that stone are found. In 1872 14,734 mining licenses were issued in the kingdom. An interesting geological change in the coast line of Sweden is the gradual rising of the land along the gulf of Bothnia and the Baltic sea. This was first observed in the beginning of the 18th century by Celsius, who attributed it to the subsidence of the waters of the Baltic; but in 1807 Von Buch made a careful examination of the coast, and announced his conviction that "the whole country, from Frederikshald in Norway to Abo in Finland, and perhaps as far as St. Petersburg, is slowly and insensibly rising." According to later observations, the greatest rise is further N. at the top of the gulf of Bothnia, where it amounts to about 4½ ft. in a century; at Gefle, 90 m. N. of Stockholm, it is from 2 to 3 ft. in a century; at Stockholm it is scarcely 6 in.; and at Malmö the movement seems to be downward.—The soil is generally not very fertile, much of it being the result of the disintegration of primitive rocks, and containing a large proportion of silex. The productive soil constitutes about 53 per cent. of the entire area, the remainder being sand barrens, rocks, and heaths. Of the productive parts about 13 per cent. are arable, 5 per cent. meadow lands and pasturage, and 82 per cent. forests. The climate of the Scandinavian peninsula is generally milder than that of other countries in the same latitude. The average winter temperature in the more populous portions of the country is but little lower than that of the state of New York. At Stockholm, in lat. 59° 20′, the mean annual temperature is about 42°, that of winter 25° and of summer 62°; at Lund, lat. 55° 42′, the annual mean is 45°, that of winter 30° and of summer 62°; at Fahlun, lat. 60° 36′, the annual mean is 40°, that of winter 22° and that of summer 58·30°; and at the Russian frontier village Enontekis, lat. 68° 30′, and at an elevation of 1,440 ft., the annual mean is 27°, the winter temperature 2° and the summer 55°. In Swedish Lapland there are scarcely two months of summer. In Norrland, in nine weeks, hay will have been cut twice and the year's seeding and harvest completed. At Stockholm the longest day is 18½ hours and the shortest 5½ hours; at Tornea 22 hours is the longest; and at Enontekis the sun remains above the horizon about seven weeks.—The pine and fir forests of Sweden furnish a great abundance of timber, which is largely exported. In the middle province there are also considerable quantities of ash, linden, willow, maple, and the weeping birch, one of the most beautiful of northern forest trees. In the southern province the oak attains great size and beauty, and the beech and elm are common. With the exception of the cherry there are few fruit trees N. of the 60th parallel, and scarcely any trees grow N. of the 64th parallel. Barley is cultivated in all parts of Sweden, and rye, wheat, oats, beans, peas, and potatoes are successfully grown in the middle and southern provinces. Apples and pears grow in the southern districts, and cranberries and other berries in the northern. The gooseberry grows all over the country. Tobacco is raised in the vicinity of Stockholm. Root crops are largely cultivated. The agricultural crops in 1874 were as follows, in imperial bushels: wheat, 4,000,000; rye, 20,000,000; barley, 12,000,000; oats, 30,000,000; potatoes, 52,000,000. Large quantities are also raised of peas, beans, mixed grain, buckwheat, hemp, and hay. During the year ending Sept. 30, 1873, 11,852,049 bushels of cereals were exported from Sweden; and the total imports of grain, flour, and meal during the same time were 2,326,581 bushels. The crops of 1874 were below the average, and the importations of grain were larger than in 1873.—The fauna of Sweden is not so numerous as that of some of the other northern countries of Europe. The principal quadrupeds are the brown bear, wolf, lynx, fox, glutton, deer, reindeer, elk, marten, otter, beaver, sable, hare, and squirrel. Bears, elk, deer, and beavers are now scarce. Wild reindeer are sometimes met with in the northern provinces. Lemmings occasionally come down in droves from the Kiölen mountains and lay waste the country in their path. Among the indigenous birds are the eagle, eagle owl, falcon, hawk, swan, goose, eider duck and other species of wild ducks, gull, ptarmigan, capercailzie and other grouse, woodcock, blackcock, and snipe. The sheltered coasts of the Baltic and the gulf of Bothnia are the resort of immense flocks of sea fowl. The lakes, rivers, and seas abound with fish. Many of the rivers contain fine salmon, trout and grayling are caught in every mountain stream, and pike and perch abound. The turbot, cod, mackerel, ling, and herring are taken in considerable quantities, and lobsters, crabs, and

oysters are abundant. Great numbers of the *strömming*, a small fish about as large as a sprat, are caught in the gulfs of Bothnia and Finland, and cured. It is said that more than 80 kinds of salt and fresh water fish are sold in the markets of Gothenburg. The domestic animals are mostly small and of inferior quality, but efforts are making to improve the breeds, particularly of sheep. Fine animals are imported from foreign countries, and there are public breeding establishments. In 1870 there were in Sweden 1,966,500 horned cattle, 1,595,000 sheep, and about 428,500 horses.—The three great divisions of Sweden, Gothland (Sw. *Götaland*), Svealand, and Norrland, are subdivided into 24 läns or districts, the extent and population of which in 1874 were as follows:

| DIVISIONS. | Area, sq. m. | Population. | CAPITAL. |
|---|---|---|---|
| GOTHLAND. | | | |
| Malmö | 1,847 | 325,909 | Malmö. |
| Christianstad | 2,507 | 227,008 | Christianstad. |
| Blekinge | 1,165 | 129,521 | Carlscrona. |
| Kronoberg | 3,840 | 162,233 | Wexiö. |
| Jönköping | 4,299 | 184,210 | Jönköping. |
| Calmar | 4,446 | 236,914 | Calmar. |
| Ostergötland | 4,145 | 261,891 | Linköping. |
| Halland | 1,901 | 130,008 | Halmstad. |
| Skaraborg | 3,310 | 249,089 | Mariestad. |
| Elfsborg | 4,948 | 283,692 | Wenersborg. |
| Gothenburg and Bohus | 1,953 | 239,587 | Gothenburg. |
| Gottland (island) | 1,212 | 54,284 | Wisby. |
| Lakes Wener and Wetter | 2,729 | ...... | ............ |
| Total | 38,302 | 2,484,346 | |
| SVEALAND. | | | |
| Stockholm | 2,860 | 230,801 | Stockholm. |
| Upsal | 2,015 | 102,629 | Upsal. |
| Södermanland | 2,603 | 138,606 | Nyköping. |
| Westmanland | 2,519 | 119,485 | Westeras. |
| Orebro | 3,503 | 174,893 | Orebro. |
| Wermland | 6,520 | 265,027 | Carlstad. |
| Kopparberg | 11,240 | 181,258 | Fahlun. |
| Lakes Mælar and Hjelmar. | 659 | ...... | ............ |
| Total | 31,949 | 1,262,789 | |
| NORRLAND. | | | |
| Gefleborg | 7,464 | 157,196 | Gefle. |
| Wester Norrland | 9,515 | 143,614 | Hernösand. |
| Jämtland | 19,586 | 73,593 | Ostersund. |
| Westerbotten | 23,865 | 96,084 | Umea. |
| Norrbotten | 41,069 | 80,350 | Pitea. |
| Total | 101,499 | 550,837 | |
| Total of Sweden | 171,750 | 4,297,972 | |

Gothland (the region originally inhabited by the Goths) lies S. of lat. 59°, and comprises also the islands of Öland and Gottland; Svealand, the original country of the Svenskar or Swedes, extends from Gothland northward to about lat. 60° 15′ at its eastern extremity, and lat. 62° 15′ at the western; and Norrland is the whole northern part up to the Norwegian frontier of Finland. In 1874 Sweden had 89 towns, only one of which, Stockholm, the capital, had more than 100,000 inhabitants (147,249). Of the others, Gothenburg had 61,599, Norrköping and Malmö from 25,000 to 30,000 each, and Carlscrona, Gefle, Upsal, Lund, and Jönköping from 12,000 to 18,000 each.—Besides the Swedes proper, the population of Sweden in 1870 included 6,611 Lapps, 27,079 Finns, and 12,015 foreigners; of the last, 2,856 were Germans, 2,795 Danes, 2,570 Norwegians, 2,018 Finlanders, 806 Russians, 355 English, 157 Americans, 122 French, and a few of other nationalities. Besides the members of the Lutheran church, to which nearly all the native population belong, there were in 1870 3,809 Baptists, Methodists, and Mormons, 1,836 Jews, 573 Roman Catholics, 30 Greek Catholics, and 190 of the Reformed church. The number of householders in 1870 was 1,017,323. The average number of marriages in every 10,000 inhabitants during the decade ending in 1870 was 65·44; the whole number of divorces during the same period was 1,301. The proportion of illegitimate births in the whole kingdom in 1873 was 11 per cent., and in Stockholm 38·15 per cent. In 1870 the number of paupers wholly supported at the public expense was 85,147, and the number of convicts in all the prisons was 5,951. Intemperance, which has heretofore prevailed so extensively as to mar the character of the people, has been checked by wise legislation, and crime has decreased; but the consumption of distilled spirits as drink is still large, in the proportion of about 2½ gallons a year to each inhabitant. Monday, as well as Sunday, is often spent by working men in dissipation, which has given rise to the phrase "free Monday." Like the other branches of the Scandinavian race, the Swedes are tall and of a sandy or florid complexion and powerful physique. As a nation they are enterprising, energetic, honest, and thrifty. More than half of the population belong to the peasantry or *bonde* class, who are gradually absorbing the landed property of the kingdom. They are mostly engaged in agriculture, and are industrious and prudent. The cottager or *torpar*, who hires his house and patch of ground, is below the peasant in social rank. The law formerly prescribed the costumes for the lower classes, but now all dress as they please. In Dalecarlia (the region on both sides of the Dal) the peasants of each parish have different and fanciful costumes. Wooden shoes or leather shoes with wooden soles are largely worn. Men, women, and children labor together in the fields; women do various kinds of outdoor work in the towns, such as the mixing of mortar and the tending of masons, and most of the drudgery in factories. By law no children under 12 years of age can be employed in a factory, and none under 18 can be required to work after dark. In 1873 more than 26,000 persons were employed in the mines and in mining industry. The class of burghers are members of the various mercantile guilds or are engaged in manufacturing. The nobility consists of about 1,600 families. They formerly possessed one fifth of the landed property of the kingdom, but many of them are now very poor, and their pride will not permit them to en-

gage in commercial or industrial pursuits. Although their political power as a distinct class was annulled by the reform of the constitution in 1866, they still hold the chief offices in the state, and in one of the guard regiments only noblemen are commissioned officers. There has of late been a large emigration from Sweden, chiefly to the United States, which in 1869 amounted to 39,069; but it decreased in 1870 to 29,003, in 1871 to 17,450, in 1872 to 15,915, and in 1873 to 13,580.—Sweden has made great progress in manufacturing industry within the past few years. While the number of distilleries, of which in 1835 there were 85,172 small and 670 large ones, had diminished in 1866 to 565, other branches of industry have greatly increased. The value of the goods produced in the registered manufactories of the country in 1830 was $3,500,000; in 1840, $5,700,000; in 1850, $10,900,000; in 1860, $18,500,000; in 1865, $20,300,000; and in 1870, $24,700,000. These sums are exclusive of the products of hand trades, which are estimated to be equal in value to the manufactures proper. The number of manufactories in 1830 was 1,857, in 1865 2,315, and in 1870 2,183. In 1870 the manufactories produced cloth valued at $2,300,000; other textile fabrics, $1,500,000; silk, $290,000; cotton spinning, $2,300,000; leather, $1,300,000; tobacco, $1,600,000; sugar, $3,500,000; metals, $2,100,000; and paper, $760,000.—The following table shows the value of the imports and exports for the five years ending with 1873:

| YEARS. | Imports. | Exports. |
|---|---|---|
| 1869 | $36,610,000 | $33,720,000 |
| 1870 | 37,970,000 | 40,870,000 |
| 1871 | 45,340,000 | 42,150,000 |
| 1872 | 58,090,000 | 53,550,000 |
| 1873 | 72,746,000 | 59,470,000 |

Partial returns for 1874 show a further relative increase in imports and a decrease in exports. The imports from the United States in 1873, direct and indirect, amounted to $7,476,878; the exports to the United States, $3,073,074. The chief imports of Sweden are textile fabrics, groceries, mineral ores and manufactured metals, ships, carriages, and machinery, bones and hides, yarn, thread, and spinning materials, wines and alcohol, colors and dyes, and coin. The chief exports are timber, metals, grain, cattle, provisions (animal), tallow and oil, and paper and paper goods. The direct imports from the United States are petroleum, resin, tallow, and agricultural machines and implements; indirect, cotton, pork, tobacco, sewing machines, and gold and silver bullion. The merchant marine of Sweden in 1872 numbered 3,878 vessels (including 498 steamers), of 426,000 aggregate tonnage.—Sweden has remarkable facilities for internal navigation through a series of lakes, rivers, and bays, connected by more than 300 m. of canals. These furnish direct water communication between the Baltic and the North sea, which is of great importance, as in case of war the Danes would command the channels through the Belts and the Sound. The importance of this connection was well understood in the 12th and 13th centuries, but Gustavus Vasa was the first to undertake it. Various sovereigns continued the work, and in 1823 the line was opened from Söderköping on the Baltic through Lakes Wetter and Wener. The canal from Lake Wener around Trollhätta falls, originally built in 1800, was next enlarged and rebuilt, and in 1855 the entire route was thrown open for steamers. It is in all 235 m. long, of which about 60 m. are across the lakes. Its most elevated point is Lake Wiken, between Wetter and Wener, where it is 299 ft. above the level of the sea; the descent is made by vessels on each side through 37 locks. Other canals connect the Mælar lake with Lakes Hjelmar and Barken, and with the Baltic. There are excellent roads all over the country, and in winter, when the canals and lakes are frozen and the ground is covered with snow for four or five months, communication is easily kept up with the interior by means of sledges. A network of railways is now in course of construction, to connect all the important districts of the kingdom, chiefly at the expense of the government. The state lines include the main or trunk lines, the principal of which are the western, from Stockholm to Gothenburg, and its branches; the southern, from Falköping on the western line to Malmö; the northwestern, from Laxa on the western line to the frontier of Norway; the eastern, from Kathrineholm on the western line to Norrköping; and the northern, connecting Stockholm with the principal cities of the north. In August, 1874, 1,639 m. were in operation, of which 878 m. belonged to the state and 761 m. to private companies; 1,744 m. were in construction, 437 m. by the state and 1,307 m. by private companies. At the beginning of 1875, 451 m. had been finished, making the total length of all the railways at that time 2,090 m. Of the telegraph lines, all of which, excepting those belonging to private railway companies, are the property of the state, 4,654 m. were in operation in 1872, with 10,081 m. of wires; of these, 177 m. were submarine cables. The number of post offices in the kingdom in 1872 was 546, and the number of letters passing through the mails was 14,465,572.—Previous to 1858 the unit of money in Sweden was the *riksdaler* (government dollar). The wars prior to 1815 depreciated the Swedish paper money greatly, and the government notes were of less value than those issued by the bank, which was an independent institution, though under the management of directors appointed by the legislature. The specie dollar was 106 cts., the *riksgalds* (royal debts) dollar 26¼ cts., or four to the specie dollar; while the *riksdaler banco*, or bank dollar, was

39⅜ cts., or three eighths of the specie dollar and 1½ of the riksgalds. The riksdaler banco hence became the official money of accounts. All three (the specie, banco, and riksgald) were divided into 48 *skillings*, and the skilling into 12 *rundstyks*. In 1854 the diet adopted a decimal system, which was put into operation Jan. 1, 1858. In this system the riksgald dollar (26½ cts.) is the unit; it is called the *riksdaler ryksmint*, and divided into 100 *öres*. In 1872 a convention was signed at Stockholm by the plenipotentiaries of Sweden, Norway, and Denmark, for the introduction of a common system of coinage into the Scandinavian kingdoms. This was ratified by Sweden, and the new coinage was put into circulation on Jan. 1, 1875. The basis is gold, with silver and bronze for the smaller coins, the unit being the *kronor* or crown (26⅘ cts.) of 100 öres. The gold coins, which are an alloy of 90 parts gold and 10 copper, are the 10-crown piece and the 20-crown piece. The silver coins have an alloy of copper, and consist of pieces of one and of two crowns, and of 50, 40, 25, and 10 öres respectively. The bronze coins are of 95 parts copper, 4 tin, and 1 zinc, and are of the respective values of 1, 2, and 5 öres. In weights, the Swedish pound, which is the unit, is equal to 0·937 of the pound avoirdupois; it is subdivided into 100 *orts* of 100 *korns* each; 100 pounds make a *centner*, and 100 centners a *nyläst*. In length, one Swedish foot is equal to 0·974 of an English foot, and is divided into 10 inches of 10 lines each. The Swedish mile is equal to 6·6235 English miles; the square mile to 43·87 English square miles. The measure of contents has the Swedish cubic foot for its unit, divided into 10 *cans* of 100 cubic inches each.—Sweden and Norway form a single kingdom, but have separate internal administrations, the king residing alternately in each country. (See NORWAY.) The government is a limited monarchy, hereditary only in the male line. The king is sole executive of the realm, commander of the land and sea forces, and head of the church, and has the right to preside in the supreme court of justice. He must be a member of the Lutheran church. His person is inviolable, and his action exempt from censure, but he is required in Sweden to advise and consult with a council of state composed of ten members, two of whom, called ministers of state, hold the portfolios of justice and of foreign affairs, and eight of whom are called councillors of state; of the latter, five are the chiefs respectively of the departments of marine, war, finance, ecclesiastical affairs, and the interior, and three have only consultative voices. All the members of the council are responsible for the acts of the government. In practice the king submits all measures excepting military and diplomatic affairs to his councillors, but he is not bound to follow their advice. If he proceeds to unconstitutional measures, they must make a formal protest or be held responsible before a high court convened for their trial. During the absence of the king in Norway, Sweden is governed by a regency named by him, consisting of a prince of the blood or a minister of state and three councillors. In case of his absence in a foreign country, or of the minority of the sovereign, the two kingdoms are governed by a joint regency consisting of ten Swedes and ten Norwegians. The law-making power is vested in a legislature called the diet, which previous to the amendment of the constitution in 1866 consisted of four houses, respectively of the nobles, clergy, burghers, and peasants, but is now divided into an upper and a lower chamber. The upper chamber has one member for every 30,000 of population (in 1874, 128), who are elected for nine years and receive no salary. Each member must be more than 35 years old, and must have possessed for at least three years previous to election real estate of the taxed value of 80,000 riksdalers, or an annual income of 4,000 riksdalers. There are only 6,000 Swedes eligible to a seat in this chamber, of whom about 1,750 reside in the country. Members are elected indirectly, in cities by the municipalities and in the country by the 25 provincial assemblies. These assemblies, called *landsting*, are selected by electors chosen by the people in the communal or parish elections, in which each property owner, male or female, is allowed one vote to each 100 riksdalers of taxable income. In the cities no one can cast more than 100 votes, the number authorized by 10,000 riksdalers of income. The lower chamber consists of one representative for every 10,000 inhabitants of towns, of one deputy for every rural district whose population is less than 40,000, and two deputies for those of more than 40,000. In 1874 the number of members was 194, of whom 56 represented the towns and 138 the rural districts. They are elected for three years, and receive each a salary of 1,200 riksdalers for the session of four months and travelling expenses. They are chosen generally by direct vote, although they may be by indirect vote at the option of a district. Every male Swede 21 years of age and over, who owns real property of the assessed value of 1,000 riksdalers, or holds a five years' lease of property of the value of 6,000 riksdalers, or pays an income tax on 800 riksdalers is entitled to vote in their election; and if he is 25 years old and has possessed these property qualifications for one year preceding the election, he may be elected a member. The diet assembles every year, on Jan. 15, without special convocation. The king appoints the president and vice president of each chamber. The diet appoints: 1, a lawyer as procurator general to superintend the execution of the laws by judges and officers; 2, a committee of 48 members, every third year, to report whether the members of the supreme court deserve to retain their positions; and 3, a committee of six members, also

every third year, to watch with the procurator general over the liberty of the press. Laws for changing or abolishing rights of the nobility require the consent of an assembly of nobles, and ecclesiastical laws can be enacted, changed, or abrogated only with the consent of a general church assembly. The king has the right of absolute veto of any measure passed by the diet. The judiciary consists of the supreme court of the kingdom, composed of 16 judges in two divisions, which interprets the laws and renders justice in the name of the king, who when he presides has the right of two votes; three royal courts of justice, sitting at Stockholm, Jönköping, and Christianstad; a royal court of military justice; and a supreme court of admiralty. There are also throughout the kingdom petty courts, of which the clergy are often magistrates.—The estimate of receipts and expenditures of the administration for the year 1875 is as follows:

GROSS RECEIPTS.

| | | |
|---|---|---|
| Ordinary revenue, including land tax, receipts from railways, telegraphs, forests, tonnage dues, &c. | | 25,135,000 |
| Extraordinary: | | |
| Customs | 19,500,000 | |
| Posts | 3,400,000 | |
| Stamps | 1,880,000 | |
| Impost on spirits | 12,000,000 | |
| " on beet sugar | 60,000 | |
| Income tax | 2,800,000 | 39,640,000 |
| On account of the public debt: | | |
| Cash, interest, &c. | 11,037,939 | |
| Loan of 1872 for construction of railways | 9,437,000 | |
| Remainder of do. and new loan | 14,000,000 | 34,474,939 |
| Total receipts | | 99,249,939 |

EXPENSES.

| | | |
|---|---|---|
| Ordinary: | | |
| Royal household | 1,266,000 | |
| Justice | 3,340,400 | |
| Foreign affairs | 609,365 | |
| Army | 11,710,400 | |
| Navy | 4,459,100 | |
| Interior | 11,591,500 | |
| Church and public instruction | 6,822,900 | |
| Finance | 10,498,000 | |
| Pensions | 1,539,135 | 51,836,800 |
| Extraordinary, including railway construction, army and fleet, and supplement to budget of 1874 | | 28,447,108 |
| On account of the public debt: | | |
| Liquidation of loans for railway construction | 11,557,185 | |
| Loaned for construction of private railways | 2,000,000 | |
| Various expenses | 5,408,845 | 18,966,031 |
| Total expenses | | 99,249,939 |

At the close of 1873 the total public debt amounted to about 122,080,000 crowns. From this must be subtracted credits of about 32,-240,000, which leaves the actual debt about 89,840,000 crowns. The whole of this debt was contracted for railway construction, and all in Germany, with the exception of two loans of about 30,000,000 crowns in the aggregate, which were negotiated in London. All the loans are paid off gradually by means of a sinking fund. In 1872 the diet authorized the emission of a new loan of 24,000,000 riksdalers, at 4 per cent., to continue the construction of the railways; but the budgets of 1872 and 1873 having exhibited surpluses, only 6,650,000 had been issued up to May, 1874. Sweden has but one colony, the island of St. Bartholomew in the West Indies, the administration of which costs 25,000 crowns per annum.—The army of Sweden is composed of five classes of troops, the *värfvade* or enrolled troops, the *indelta* or military colonists, the *beväring* or conscripted troops, the militia of Gottland, and volunteers. The active army consists of the first two of these classes. The värfvade are enlisted usually for six years; they comprise a body of about 6,000 men, among which are the royal life guards, the artillery, the engineers, and one regiment of hussars. The indelta consist of about 25,000 men, 21,000 of whom are infantry, the remainder cavalry. This body, which was established by Charles XI., is peculiar to Sweden. The men are cantoned in military districts, where they are provided for by the holders of crown lands in those districts. Each man has also assigned to him a house and a piece of land, which he cultivates for himself. The infantry are exercised annually 30 days and the cavalry 46 days. The remaining three classes constitute the reserve. The beväring are drawn by annual levy from the whole male population between the ages of 20 and 25. The right to purchase substitutes was abolished by the diet in 1872. In 1873 this body numbered 86,101 men. The militia of Gottland have a separate command, and cannot be obliged to serve out of the island; they number usually about 8,000 men. The volunteers were first organized in 1861. In time of peace they are subject only to their own rules, although their commanders are chosen by the king; but in war they may be compelled to serve under the military authorities. About 20,000 were enrolled in 1873. The effective force of the kingdom in 1873, including all the five classes, was 150,773 men. The navy was entirely reorganized in 1873, and now forms a single body called the royal fleet, with two stations, at Stockholm and Carlscrona. It consisted in 1874 of the following vessels: steamers—1 ship of the line with 66 guns, 1 frigate with 22 guns, 2 corvettes with 14 guns, 4 monitors with 8 guns, 10 small monitors (4 constructing) with 10 guns, 12 gun boats with 21 guns, 4 vessels without guns, 1 transport with 1 gun, and 2 despatch boats with 5 guns; sailing vessels—1 frigate with 36 guns, 5 corvettes with 102 guns, 1 brig with 10 guns, and 1 schooner with 8 guns; rowing vessels—4 mortar boats with 5 guns, 44 gun boats with 98 guns, and 40 launches with 49 guns; in all, 133 vessels with 455 guns. The navy is officered by 2 rear admirals, 6 commanders, 20 captain-commanders, 43 captains, 43 lieutenants, and 26 sous-lieutenants; it has an effective force of about 7,000 men, and a reserve of 35,000 men.—The Lutheran is the established church of Sweden, but all sects are tolerated. Previous to 1873,

when the church assembly assented to the act of the diet permitting civil marriages and marriages by dissenting ministers, no one not confirmed in the Lutheran faith could be legally married. Every Swede who does not claim to belong to some one of the dissenting sects must be confirmed at the age of 14 or 15 and partake of the sacrament, upon which he receives a certificate from his pastor. If he neglects the requirement, he is subject to many inconveniences, and is not entitled to the same burial rites as a confirmed person. The clergy, who must be graduates of one of the universities, are generally moral and high-toned, and exercise a controlling influence in society. In the country parishes they are often magistrates as well as pastors. They receive in general a liberal income from permanent funds, tithes, and fees, but some are poorly paid. They are usually elected in parish meeting and commissioned by the king. The head of the church is the archbishop of Upsal, who has under him 11 bishops, respectively of Linköping, Skara, Strengnäs, Westeras, Wexiö, Lund, Gothenburg, Calmar, Carlstad, Hernösand, and Wisby. The archbishop and bishops are nominated by the king from a list of candidates presented by the dioceses. Ecclesiastical matters are discussed in convocation, but are subject to the decision of the king.—Public instruction is gratuitous and compulsory, and it is rare to meet with any one who cannot read and write. Primary schools exist in every parish, excepting in the northern districts, which are so thinly peopled as to render movable schools necessary. Children who do not attend schools under government supervision must furnish evidence of private education. In 1870 nearly 97 per cent. of the children from 8 to 15 years of age attended the public schools. The whole number of common schools in the kingdom was 7,303, with 555,595 pupils; of these 1,164 were movable schools. In 1871 the number of male teachers in the common schools was 5,029, of whom 52 were clergymen and 1,057 church clerks; the number of female teachers was 2,776. The amount paid for the support of common schools in 1871 was 3,537,968 riksdalers, of which 2,573,927 was contributed by parishes, 842,907 by the state, and 121,133 was derived from interest on endowments. In 1870 there were 98 high schools for boys, with 756 teachers and 12,755 pupils. No high schools were provided for girls till 1873, when one was established at Carlstad. There are also technical schools and day and evening schools in the several cities. The universities of Upsal and Lund have faculties of theology, law, medicine, and philosophy. In 1873 the former had 1,611 and the latter 563 students. Preparations are nearly completed for founding a free university at Stockholm. There is a military school at Carlberg, a higher military academy for officers of engineers and of artillery at Marieberg, and a school for naval cadets at Stockholm. Libraries and collections of art, natural history, &c., exist in all the cities, and are free to the public on certain days, and there are many literary and scientific societies in the kingdom. Almost every parish, every prison, and all the large industrial establishments have their libraries. In 1875 there were 271 newspapers and periodicals published in Sweden, of which 12 were daily and 16 were illustrated.—The early history of Sweden is confused and mythical. When Odin and his Swedes entered the country, they found a great part of it in the possession of the Goths, who had dispossessed the Lapps and Finns, and the kingdom which he founded comprised only a portion of Svealand, or the central province. (See Denmark, Northmen, Norway, and Odin.) The dynasty of the Ynglings, founded by Frey-Yngve, son of the pontiff Njord, Odin's successor, ended, it is supposed, before the 8th century, with Ingjald Illrada. He was succeeded by Ivar Vidfamne, who ruled over both the Swedes and the Goths. In 829 Ansgar or Anscarius, a monk of Corbie, visited Sweden and converted many pagans, but did not succeed in establishing Christianity. About the year 1000 Olaf Skotkonung (the lap-king, so called because he received homage when an infant) was baptized, and a bishopric was erected at Skara, but Svealand would not receive Christian teachers for more than a century afterward. Constant disputes and often open war existed for centuries between the Goths and the Swedes, and their political union was not completed until the reign of Waldemar, son of Birger Jarl (Earl Birger), who was made king in 1250. Finland had in the mean while been conquered and Christianized. In 1279 Magnus Ladulas (Barnlock, so called because he protected the people's granaries from the rapacity of the nobles) ascended the throne and reigned with ability till his death in 1290. Then followed a long period of dissension between his three sons. In 1319 Magnus Smek, an infant, became king, and in the next year succeeded by right of his mother to the throne of Norway. He established his son Haco in Norway, and induced him to marry Margaret, daughter of Waldemar, king of Denmark. The three Scandinavian states being thus allied, he attempted by the aid of the kings of Norway and Denmark to abolish the senate, but was deposed and Albert of Mecklenburg was elected king in 1363. A war ensued between him and the kings of Denmark and Norway, which ended in Albert's defeat, and on July 20, 1397, by the "union of Calmar," Margaret, "the Semiramis of the North," became queen of the confederate monarchy of Sweden, Norway, and Denmark. She retained possession of the triple government till her death in 1412, and was succeeded by her grand-nephew Eric of Pomerania (XIII.). The union of Calmar was maintained with great difficulty for more than 100 years, though in 1434–'6

it was seriously perilled by the efforts of the Swedes under the leadership of Engelbert, a patriotic Dalecarlian miner, and but for his assassination by the treachery of a Swedish noble in 1436 would have been overthrown. In 1439 Eric was deposed, and his nephew Christopher of Bavaria chosen king; and on his death in 1448 Karl Knudsson, who had been regent at the deposition of Eric, succeeded him. Anarchy ensued under him and his successors till 1520, when Christian II. of Denmark became king. He exasperated the people by his cruelty, and they found a leader in Gustavus Ericsson, a noble of high rank, better known as Gustavus Vasa. (See Gustavus I.) Christian had executed as traitors and heretics many of the principal nobles, among them the father of Gustavus, and a great number of peasants. The resistance of the Swedes under Gustavus to the government of the Danish king was successful, and in 1523 they elected their leader king. In 1529 he introduced the reformation. At his death in 1560 he was succeeded by his son Eric XIV., who was deposed on account of alleged insanity in 1568 by his brother John III. (See Eric XIV.) John reigned till his death in 1592, when his son Sigismund, who had been elected king of Poland and had become a Roman Catholic, succeeded him, the late king's brother, Duke Charles, being regent till he could leave his kingdom of Poland. Sigismund determined to establish Romanism in the kingdom, against the will of the people, and showed himself so reckless and unscrupulous, that in 1599 he was deposed, and in 1604 his uncle Charles IX., who had acted as regent, was raised to the throne. (See Charles IX.) His reign was one of tranquillity in the kingdom, and in 1611 he died, leaving the throne to his son Gustavus Adolphus. (See Gustavus II.) After a reign of 21 years, the greater part of which was spent in wars with Poland and Russia for the possession of Ingria, Livonia, and other territories on the Baltic, and in the defence of Protestantism in Germany, while his affairs at home were managed successfully by the wise Oxenstiern, Gustavus closed his glorious career at the battle of Lützen in 1632, and his daughter Christina, then six years of age, succeeded him. (See Christina.) Oxenstiern was invested with the chief management of affairs; Baner, Torstenson, and other Swedish generals won new victories; and the kingdom for a time prospered, and by the peace of Westphalia in 1648 received western Pomerania and other accessions of territory. After Christina's coming of age, her want of fixed principles and the violence of her disposition soon plunged the country into debt and trouble, and in 1654 she abdicated in favor of her cousin Charles X. His reign of six years was marked by brilliant campaigns against the Danes and in Poland, and acts of great personal bravery; but his victories brought no advantage to Sweden, and only wasted her resources. (See Charles X.) He died in 1660, and was succeeded by his young son Charles XI., during whose minority a peace was concluded by which the kingdom had 10 or 12 years of tranquillity. In 1676 began a war with the elector of Brandenburg and the Danes, which was continued with varying success, though for the most part with disaster, till 1679, when the peace of St. Germain, leaving the Danes at the mercy of the Swedes, enabled the latter to regain more than they had lost. An advantageous peace was concluded between the two kingdoms, and confirmed by the marriage of Charles to Ulrica, the daughter of the Danish king. During the remainder of his life he devoted his attention assiduously to the settlement of the troubles existing between the nobles and the peasants, and in 1693 prevailed upon both parties to give him the power to alter the constitution as he pleased. He died in 1697, bequeathing to his son Charles XII. this absolute power. (See Charles XII.) The warlike career of this remarkable but reckless king, who humbled Frederick IV. of Denmark and Peter the Great of Russia, and dethroned Augustus II. in Poland, but succumbed at Poltava, well nigh reduced his country to ruin. At his death in 1718, his sister Ulrica Eleonora, wife of Frederick of Hesse-Cassel, after renouncing absolute authority and accepting a constitution from the nobles which restored their power, was elected by the diet to the succession. She soon surrendered the government to her husband, whose reign was a period of humiliation, during which Sweden made peace with her enemies on most disadvantageous terms, and gave up most of her Transbaltic possessions, including Livonia, Esthonia, and Ingria, which had been occupied by Peter the Great. War with Russia in 1741 resulted in defeat, and the cession in 1743 of eastern Finland. Frederick died childless in 1751, and was succeeded by Adolphus Frederick of Holstein-Eutin, bishop of Lübeck, whose election as successor had been made by the empress Elizabeth of Russia a condition of the peace of 1743. French influence corrupted the senate during his administration, and involved the country in a disastrous war with Prussia. After a turbulent reign of 20 years he died in 1771, and was succeeded by his son Gustavus. (See Gustavus III.) The revolution of August, 1772, by which Gustavus attained absolute power, and the wars which followed with Russia and Denmark in 1787, and the act of safety of 1789, which abolished the senate, were the most marked events in the Swedish history of that time. He was assassinated in 1792, and his son Gustavus IV. (see Gustavus IV.) ascended the throne; but as he was a minor, his uncle the duke of Södermanland (Sudermania) was appointed regent. In 1809 the king's imprudence and tendency to insanity led to his compulsory abdication, and his uncle was declared king under the title of Charles XIII. (See Charles XIII.) The peace made

with Russia at this time deprived Sweden of Finland. A new constitution was decreed, and the prince of Holstein-Augustenburg was elected heir to the throne as crown prince. The sudden death of this prince in April, 1810, led very unexpectedly to the nomination of Bernadotte, prince of Ponte Corvo (see BERNADOTTE), as crown prince, whose success in securing Norway to Sweden (the rest of Swedish Pomerania being given up) endeared him to the people. In 1818, on the death of Charles XIII., he ascended the throne as Charles XIV. John. During his reign Sweden prospered, commerce, the arts, and manufactures made rapid progress, and the moral and social condition of the people was greatly advanced. His son Oscar I. succeeded him at his death in 1844, and encouraged the moral, social, and political progress of the country. (See OSCAR I.) At his death in 1859, he was succeeded by his son Charles XV., who had been regent of the kingdom since 1857 in consequence of King Oscar's illness. (See CHARLES XV.) During the Crimean war Sweden and Norway remained neutral. Many constitutional reforms were effected during Charles's reign. On his death in 1872 without male offspring, he was succeeded by his brother Oscar II., who has continued his liberal policy. (See OSCAR II.)

**SWEDEN, Language and Literature of.** The Swedish is one of the Scandinavian tongues, and as such belongs to the Germanic (or Teutonic) branch of the family of the Indo-European languages. (See GERMANIC RACES AND LANGUAGES.) Though Old Norse proper was the speech of the whole Scandinavian peninsula and of Denmark until the 11th century, its dialects varied considerably even in the most primitive times, and out of one or more of those ancient dialects the modern Swedish was developed. The change was so slow that the Icelandic lays and sagas were still understood at the Swedish courts as late as the 14th century. (See ICELAND, LANGUAGE AND LITERATURE OF.) In its earlier stages the Swedish was influenced by the German through the commercial connection of Sweden with the Hanseatic towns, by the Latin through the Catholic priesthood and the monastic institutions, and by the Danish through the political union of Sweden and Denmark subsequent to the pact of Calmar (1397). The reformation again subjected it to German influences, but it was less affected by them than was the Danish. The language was greatly purified and a multitude of foreign vocables driven out by the efforts of the zealous Icelandic scholars of the latter half of the 17th and first quarter of the 18th century. But later in the last century the French tastes prevalent at the court and in the literature introduced a large number of Gallic words, many of which, however, have been since superseded by genuine Scandinavian derivatives. Several dialects are now spoken. In the northern provinces the approximation to the Old Norse or Icelandic forms is much more marked than in the southern, where Danish and German influences have been felt; the southern dialects of Scania and Blekinge have great similarity to the Danish, and that of Dalecarlia presents the greatest departure from the written language, while that of Södermanland approaches it the nearest. Swedish is also the language of the educated classes, and partly of the press, in the Russian grand duchy of Finland.—The Swedish alphabet has 28 letters, the same as in English, with the omission of *w* (in Swedish formerly the equivalent of *v*, by which it is now generally replaced) and the addition of *ä*, *å*, *ö*. Formerly the German character was mostly used in Swedish works, but now the Latin character prevails, though the former is still sometimes to be found. A letter peculiar to the Swedish is *å*, which is pronounced almost like the English *o* in *note*. The vowels *a*, *e*, *i*, *ä*, and *ö* are pronounced as in German; *o* has two sounds, either similar to that of the English *o* in *move*, but intermediate between *o* and *u*, or equivalent to the English *a* in *fall*. The sound of *u* is intermediate between the German *u* and *ü*. *Y* is pronounced almost like the German *ü*. *G* before *e*, *i*, *y*, *ä*, *ö*, has a sound like the English *y* in *you*. *J* has the same sound. *D*, *g*, *h*, and *l* before *j*, and *h* and *f* before *v*, are mute. *K* before *e*, *i*, *y*, *ä*, *ö*, is soft and pronounced like *ch* in *much*. *Sk* before the same letters, and the combinations *skj*, *sj*, *stj*, are pronounced like the English *sh*. The indefinite article *en* (masc. and fem.) and *ett* (neut.) is placed before the noun; as *en häst*, a horse, *ett bord*, a table. The definite article is *den* in the masculine and feminine, *det* in the neuter, and *de* in the plural for all genders; but it is also expressed by only adding in the singular number *en* or *n* to masculine and feminine substantives, and *et* or *t* to the neuter, and in the plural *ne*, *na*, *a*, *en*; or, thirdly, both these ways may be combined, as *den mannen*, the man, *det bordet*, the table, *de hästarne*, the horses. Substantives have a distinct case ending only in the genitive, which is formed by the addition of *s*. The plural of substantives is formed by adding *or*, *ar*, *er*, or *en*; and in some words the singular and plural are alike. The adjectives are formed after two declensions, the first of which has a separate form for the neuter gender, while the second has only one form for all the three genders. The second person singular pronoun is used in conversation only among intimates or when addressing inferiors; otherwise the title of the person addressed, or *Herr* (sir, Mr.), *Fru* (madam), or *Mamsell* or *Fröken* (miss), with the verb in the third person, must be used; thus: Have you seen the book? *Har Herrn* (Has the Mr.) *sett boken?* Verbs have a strong and a weak form of conjugation, and two simple tenses, present and imperfect. The passive is formed by adding *s* to the active; as, *att skära*, to cut, *at skäras*, to be cut; *jag kallar*, I call, *jag kallas*, I am

called. Throughout the verbs the singular is the same in all three persons; in the plural the first and third are alike, and the second ends in *en*. Among the best grammars of the language are those of Rydqvist, *Svenska Språkets Lagar* (4 vols., Stockholm, 1850–'73); Strömborg, *Svensk Språklara* (Stockholm, 1858); Funk, *Praktischer Lehrgang zur schnellen und leichten Erlernung der schwedischen Sprache* (Leipsic, 1872); and May, "A Practical Grammar of the Swedish Language" (4th ed., Stockholm, 1873). Among the best lexicons are Dalin's (2 vols., Stockholm, 1850–'54), and especially Kindblad's (3 vols., Stockholm, 1840–'73).—Literature. The literary history of Sweden has been very conveniently divided into six periods. I. 1250 to 1520. The earliest writings extant in the Swedish language are the ancient provincial laws, of which the oldest compilation, that of the province of Westergötland, was probably made about the middle of the 13th century. The poetical spirit of the nation was first developed in the *Kämpavisor*, or heroic ballads, and a little later in the *Riddarvisor*, or chivalric ballads. Of these several collections have been edited; a few of them may perhaps be ascribed to the latter part of the 13th century, but the greater part of them belong to the 14th and 15th centuries. Of greater influence upon the written language were the romances of chivalry, mostly translations and imitations of those then popular in central Europe. As many of them were translated between 1300 and 1312 by order of Euphemia, queen of Norway, they are collectively called *Drottning Euphemias Visor*, "Queen Euphemia's Songs," though many are in prose. The only noteworthy productions of the 14th century are *De stora och de gamla Krönikarna*, "The Great and the Old Chronicles," narrating the leading events of Swedish history; a translation of the life of St. Anscarius, and a "Legend of the Nun Elisif," by Bishop Hermanni; some lyrics composed by Bishop Thomas; the "Revelations" of St. Brigitta, abbess of Wadstena, and her daughter's *Sjellina Tröst*, "Soul's Trust," a paraphrase of a Latin treatise. The literary monuments of the 15th century are principally the *Codex Vadstenensis*, a collection of legends, essays, letters, and diaries, made by the nuns and monks of Wadstena; an anonymous judicial treatise, *Domarereglorna*, "Rules for Judges;" and a curious political work, *Om Konunga- och Höfdinga-styrelsen*, "On the Government of Kings and Rulers," based upon the book of an obscure Latin author, Ægidius Romanus. Printing was introduced into Stockholm in 1483, the first book printed being a collection of fables styled *Dialogus Creaturarum Moralisatus*. II. 1520 to 1600. The religious contests of the 16th century gave a theological or rather polemical character to almost the entire literature. Two brothers, Olaus Petri (1497–1552) and Laurentius Petri (1499–1573), are almost the only literary representatives of this period; they made translations of the Bible, wrote chronicles, and composed verses. A liturgy known as *Rödboken*, the "Red Book," and other minor Roman Catholic productions, called forth a mass of unimportant polemical writings. All the prose and poetry of this period deserving of mention are some chronicles of the reign of Gustavus Vasa by R. Ludviksson (died 1594), P. Svart (died 1562), and S. Elofsson; a few hymns translated from the German, and some popular ballads; a dull religious drama, *Judas Redivivus*, by Rondelitius; some hymns and a love song by King Eric XIV.; and a *Visa*, or lay, by J. af Hoja (died 1535). III. 1600 to 1718. The learned foreigners who flocked to the court of Christina, among them Descartes, Bochart, the younger Heinsius, Gronovius, Pufendorf, and Scheffer, gave an impetus to higher culture in Sweden; but as they wrote in Latin, they did little for the development of the vernacular literature. The investigations of the Icelandic literary monuments by Olof Verelius (1618–'82), Olof Rudbeck (1630–1702), and Johan Peringskjöld (1654–1720), causing the publication of Icelandic texts, principally the Eddas, were of more importance in this respect. The historical writings of Eric Tegel (died 1638), A. Girs (died 1639), Widekindi (1620–'97), Werwing (died 1697), and Adlerfeldt (1671–1709) exhibit a considerable improvement in the use of language, though they can hardly claim to be much more than heavy compilations of facts and materials. The continued religious controversies, at this time between Lutheranism and Calvinism, called into the field but few theologians who wrote in any language but Latin. The exegetical works and ecclesiastical histories, among which those of Paulinus (died 1646), Rudbeckius (1581–1646), and Winstrup (died 1679) stand prominent for theological learning, were also written in Latin, as well as the works that appeared on other subjects of scientific research. In jurisprudence the names of M. Vexionius and J. Stjernhök (1596–1675) are well known; in geography and travels, Count E. Dahlberg (1625–1703) published a *Svecia Antiqua et Hodierna*, with 353 maps and engravings of Swedish towns and castles; in classical philology, Gezelius, Lagerlöf, and Freinshemius distinguished themselves; and in botany, Rudbeckius paved the way for Linnæus. But the progress made in the literary use of the vernacular is almost wholly due to the few who attempted romance and poetry. In poetry Georg Stjernhjelm (1598–1672) held the foremost place. His most complete poetical work is *Hercules*, a sort of didactic epic in hexameters, exhibiting large imaginative power and much poetic skill. Of his masques the best is *Den fangne Cupido*, "The Captive Cupid." Stjernhjelm was the first writer of sonnets in Swedish. The drama consisted generally of dull imitations of Olaus Petri and Rondelitius, the chief writers being the historian

Messenius, who attempted to exhibit the whole of Swedish history in a series of dramas, S. P. Brask (1613–'68), and A. J. Prytz (1590–1655). More classically dramatic in form, but scarcely better in style, are the *Rebecca* of J. Beronius and the *Rosimunda* of U. Hjärne, while but little more praise can be bestowed upon the dramatic allegories of J. P. Chronander. The lyric writers may be divided into the Italian and the German school. To the former belonged G. Dahlstjerna (1658–1709), author of the *Kungaskald*, a half heroic, half elegiac poem in *ottave rime* on Charles XI., and of an unsuccessful translation of Guarini's *Pastor fido;* and G. Rosenhane (1619–'84), whose longest metrical attempt, *Venerid*, is a collection of 100 sonnets. The chief representatives of the German school were S. Columbus (1642–'79), whose lyrics and pastorals are now nearly forgotten; L. Johansson (died 1674), whose *Helicons Blomster*, "Flowers from Helicon," published under the pseudonyme of Lucidor, is a collection of epithalamiums, elegies, and erotic songs, which are less remarkable than his hymns, and P. Lagerlöf (1648–'99), author of a love song of great popularity in its day. The many-sided Spegel, some of whose hymns are worthy of mention, wrote two heavy and monotonous poems, borrowing his titles from the two epics of Milton. C. Arosell is known as the author of a volume of *Ofverskrifter*, or epigrams, a few of which are of merit. IV. 1718 to 1772. These years embrace a time of great literary activity. The natural sciences, under the influence of the world-famous Linné or Linnæus, occupy the first place. (See Linnæus.) That great naturalist was surrounded by a crowd of pupils, a large number of whom became celebrated; among them P. Forskal (1736–'63), who undertook a scientific journey to Egypt and Arabia, and whose researches were published by Niebuhr; and C. Bjerkander and J. G. Wahlbom, who illustrated the flora of northern Europe. P. Artedi (1705–'35) wrote a treatise on ichthyology, which Linnæus edited in 1738. To physiology belong the *Œconomia Regni Animalis* and *Regnum Animale* of Swedenborg (1688–1772). The entomological works of C. F. de Geer (1720–'78), in French, are still esteemed. Eminent in chemistry were Torbern Olof Bergman (1735–'84), who laid the foundation for the science of crystallography; A. F. Cronstedt (1722–'65), the discoverer of nickel; and J. G. Wallerius (1709–'85). Much attention was paid to mining by M. von Bromel (1679–1731), Swedenborg, and others. Olof Rudbeck the younger (died 1740) distinguished himself in several sciences; he published among others a work on ornithology in three volumes. N. Rosén von Rosenstein (died 1773) was the reformer of medical science in Sweden. Astronomy was illustrated by such names as A. Celsius (1701–'44), S. Klingenstjerna (1689–1785), and P. W. Wargentin (1717–'83); mechanics by C. Polhem (1661–1751) and Swedenborg; and mathematics by J. Faggot, C. Falkengren, E. O. Runeberg, and others. Jurisprudence was represented by D. Nehrman (died 1769) and O. Rabenius (1730–'72). S. Alnander, J. Benzelius, P. Munch, L. P. Halenius, P. Muhrbech, and J. Serenius were the chief writers in the various departments of theology; but the science produced no very eminent man except Swedenborg. (See Swedenborg.) The best known metaphysician was the Cartesian A. Rydelius (1671–1738); the system of Wolf was supported by P. Högström, N. Wallerius, and C. Mesterton; that of Locke by A. Schönberg (1737–1811), F. Kryger (1707–'77), and Runeberg. Johan Ihre (1707–'80) won fame by his *Glossarium Sveo-Gothicum*, a Swedish dialect lexicon, and by his researches concerning Ulfilas and the Mœso-Gothic language. The Icelandic scholars of the preceding generation were followed in the earlier portion of this period by J. F. Peringskjöld (1688–1725), E. J. Björner, Count G. Bonde (1682–1764), J. Göransson, and N. R. Brocman; but before the middle of the 18th century the taste for Icelandic studies had greatly declined. In geography and travels, E. Tuneld's description of Sweden and J. J. Björnstahl's travels through Europe deserve mention. In history, as in polite literature, Olof Dalin (1708–'63) stands at the head of this period. His journal *Den Svenska Argus*, "The Swedish Argus" (1732–'4), an imitation of the English "Spectator," exerted a weighty influence upon the prose style of the language and the literary taste of the nation; and his *Svea Rikes Historia*, "History of the Swedish Realm," though wanting in critical ability, is eloquent and pleasing. A more rigorous examination of evidence characterizes the Swedish histories of A. af Botin (1724–'90) and P. Schönström. The history of Charles XII. by G. Norberg (1677–1744), and the "Memoirs of Christina" by J. Arckenholtz, written in French, have been of great assistance to succeeding writers. O. Celsius the younger (1716–'94) wrote histories of the reigns of Gustavus Vasa and Eric XIV., and rendered a great service to Swedish letters by establishing the *Tidningar om de Lärdes Arbeten*, "Journal of the Works of the Learned," the first critical periodical in the language. A. A. von Stjernman, C. G. Warmholtz (1710–'84), E. Benzelius (1675–1743), B. Bergius (1723–'84), G. Wallin (1686–1760), and S. Loenbom (died 1776) were laborious critics, editors, and collectors, and brought to light or illustrated a great number of early Swedish monuments. Dalin's allegorical epic, *Den Svenska Friheten* ("Swedish Freedom"), his tragedy *Brynhilda*, and his comedy *Den Afundsjuke är qvick* ("The Jealous Man is sharp-witted"), are generally pleasing, though without much depth or vigor. H. C. Nordenflycht (1718–'63), a lady, left a high name as a writer of lyrics. Count G. P. Creutz (died 1785) was the author of a tolerably felicitous pastoral, *Atis och Camilla*, and Count G.

F. Gyllenborg (1731–1809) composed lyrics, elegies, satires, and fables, in a smooth and correct, but too often prosaic style. Poets of less note were Odel (died 1773), U. Rudenschöld (1698–1783), O. Bergklint (1733–1805), and O. Kolmodin (1690–1753). Subsequent to the time of Dalin the dramatic compositions, as those of E. Wrangel, H. Hesselius, O. Celsius the younger, and others, were lifeless imitations of Gallic prototypes. Such was the case too with the tedious romances of J. H. Mørk (1714–'63), the first Swedish novelist. Molière, Voltaire, Boileau, La Fontaine, Marmontel, and Fénelon were translated and sedulously imitated. V. 1772 to 1809. The earlier portion of this period took its impress to a great extent from the character of the sovereign, Gustavus III. His influence was not beneficial to the higher walks of literature, but he founded the "Swedish Academy of Eighteen" (1786), and otherwise sought to encourage letters. The pupils of Linnæus continued to be the chief scientific men of the time, and labored earnestly for the advancement of science; among them especially C. P. Thunberg, A. Afzelius, A. Sparrman, E. Acharius, O. Swartz, A. J. Retzius, and C. Qvensel. As chemists and mineralogists, the period furnished C. V. Scheele (1742–'86), regarded as one of the founders of organic chemistry, J. G. Gahn (died 1818), to whom several chemical discoveries are due, J. J. Ankarström, and S. Rinman. D. Manderhjelm (died 1810), F. Mallet, and H. Nicander were widely known for their astronomical labors. Juridical writers were M. Calonius (died 1817), L. Tengvall, and others. Medical writers were O. af Acrel (died 1807) and D. Schulz von Schulzenheim (1732–1823). There was little literary activity in the theology of the age, but the labors of A. Knös in dogmatics and of S. Ödman (1750–1829) in exegetics were of high reputation in their day. An æsthetico-metaphysical writer was Thomas Thorild (1759–1819); another name of note in æsthetics is C. A. Ehrensvärd (1745–1800). The philosopher B. C. H. Höijer (1767–1812) based his system upon those of Fichte and Schelling. D. Djurberg and C. B. Wadström (1746–'99) wrote on geography and travels. Sven Lagerbring's *Svea Rikes Historia*, though often inaccurate, was looked upon as a national work by his contemporaries, and its author was richly rewarded by the Swedish estates. His other writings are numerous. E. M. Fant (1754–1817) compiled a *Diplomatarium* and an extremely valuable collection of *Scriptores Rerum Svecicarum*. Jonas Hallenberg (1748–1834) wrote a universal history from the beginning of the 16th century, and many other works, historical, archæological, and philological. H. G. Porthan (1739–1804) investigated the history and antiquities of Finland. Special periods or departments of Swedish history were illustrated by C. G. Nordin (1749–1812), O. Knös (died 1804), J. A. Rehbinder, S. L. Gahm, and U. von Troil (1746–1803). G. Gezelius (1736–'89) compiled the first noteworthy biographical lexicon of distinguished Swedes. Under the direct influence of Gustavus III., the French taste now became almost entirely prevalent. Gustavus himself wrote some dramatic pieces of much merit, but all frigidly French. The favorite poets of his court were Kellgren, Leopold, and Oxenstjerna. J. H. Kellgren (1751–'95) was famous in his time in almost every branch of the poetic art; C. G. af Leopold (1756–1829), sometimes styled "the Voltaire of Sweden," wrote mainly didactic poems in the style of Pope, and serious lyrical pieces; Count J. G. Oxenstjerna (1750–1818) was the translator of Milton, and author of some descriptive poems. The lyrics of M. Choræus (1774–1806), the *Spastara* and *Medea* of B. Lidner (1759–'93), the poet of the passions, and the translations from Virgil, Horace, and Ovid by G. G. Adlerbeth (1751–1818), are still read with pleasure. A few poets escaped the general contagion. Foremost among these was Carl Michael Bellman (1740–'95), a song writer of the highest powers, who set his songs to appropriate melodies himself. Two of his friends, C. I. Hallman (1732–1800) and O. Kexél (1748–'96), were comic dramatic writers of worth. The verse of a female writer, A. M. Lenngren (1754–1817), possesses unusual grace and smoothness. A curious book of travels entitled *Min Son på Galejan*, "My Son in the Galley," by J. Wallenberg (1746–'78), is partly in verse, and abounds in a coarse but lively wit. The last years of this period, comprising the reign of Gustavus IV., exhibited little literary life. Freedom of the press was abolished in 1798, and a systematic censorship enforced. The Swedish academy was suspended for some months in 1795, Thorild was banished, Leopold was ordered away from the capital, and Höijer was not allowed to write. VI. 1809 to the present time. With the political revolution of 1809, the literature of Sweden was endowed with a new spirit, and greatly developed by a general use of the vernacular instead of Latin or French. Schools have largely improved both in number and character, and libraries have increased. The chemist Johan Jakob Berzelius (1779–1848) was a luminary of the scientific world scarcely less lustrous than Linnæus. (See Berzelius.) As botanists the reputation of three men has extended beyond their native land: Elias Fries (born 1794), K. A. Agardh (1785–1859), and G. Wahlenberg (1780–1851); while C. J. Hartman and N. Lilja are later laborers in this department. A geologist of great note was A. J. Erdman (died 1869). Zoölogy has a famous cultivator in Sven Nilsson, also the author of ethnographical and antiquarian works which have exercised a lasting influence on archæological studies. Other zoölogists of note are Thorell, Stolpe, Zetterstedt, Sundevall, and Malmgren. Entomology has been treated by J. W. Dalman (died 1828), C. J. Schönherr, J. W. Zetterstedt (died 1874),

C. G. Thomsen, whose *Skandinaviens Coleoptera* (1857–'70) is well known, and T. Thorell, author of a valuable work on European spiders. The chief laborer in ornithology, besides Nilsson, has been C. J. Sundevall (died 1875). Among mathematicians J. Svanberg, and among physicists Z. Nordmark (died 1828), F. Rudberg, F. W. von Ehrenheim (died 1828), A. J. Angström (1814–'74), and A. G. Theorell (died 1875), have gained considerable eminence. Medical science furnishes the names of A. O. Retzius (died 1860), his brother M. C. Retzius, and J. Hvasser. Prominent legal scholars have been L. G. Rabenius and his son T. Rabenius, E. Bergfalk (also known as a political economist), J. J. Nordström, F. Schrevelius, C. Nauman, J. C. Lindblad, J. G. Carlén (died 1874), and C. J. Schlytte (born 1795), the able editor of Sweden's ancient provincial codes. Sweden has a native philosophical school, whose founder, C. J. Boström (died 1866), developed the most purely idealistic system that has appeared. The Fichte-Schelling school is represented by the historian Geijer, the poet Atterbom, S. Grubbe, and N. F. Biberg (died 1827); while Hegel's theories have found defenders in E. S. Bring and J. W. Snellman. The Boströmian philosophy has recently been ably expounded by G. Nyblæus in a most important work on the history of Swedish philosophy (1873). Purely æsthetical are Atterbom, Hammarsköld, and A. Törneros. Swedish geography and statistics are much indebted to W. Tham and C. af Forsell. F. W. Palmblad, G. Thomée, Rietz, P. Læstadius, J. Berggren, G. von Heidenstam, Hedenborg, G. von Düben, A. Klinkowström, C. D. Arfwedsson, F. Bremer, C. A. Gosselman, and N. J. Andersson are prominent names in the literature of travels; and of late C. W. Paijkull (died 1872), by his account of Iceland, and A. E. Nordenskjöld, by his arctic researches, have gained an extended reputation. The study of Icelandic and its literature has been promoted by the labors of A. A. Afzelius, A. J. D. Cnattingius, Carl Säve, A. O. Lindfors, and G. Cederschjöld. A. Uppström published a critical edition of Ulfilas. In other philological departments M. Norberg (died 1826), C. M. Agrell (died 1840), O. F. Tullberg, J. Berggren, C. Landberg, and P. J. Petterson (died 1874) have distinguished themselves. The chief names in doctrinal theology are H. Reuterdahl, M. E. Ahlman, G. Knös (died 1837), L. G. Anjou, F. G. Hedberg, A. Wiberg, and N. Ignell. Peculiarly attractive from the union of candor, faith, and dialectical power are the popular religious works of P. Vikner. Among rationalists V. Rydberg is the most famous. In exegetics the prominent writers are B. J. Bergqvist, J. H. Thomander (died 1865), and Bishop Agardh; in pastoral theology the most noted are A. G. Knös and A. Z. Pettersson; in ecclesiastical history, Reuterdahl, L. G. Anjou, and J. J. Thomæus (died 1845). Among theological literature may also be included the elaborate work of Bäckman, *Försök till en Svensk Psalmhistoria* (1873). The teachings of Swedenborg have been zealously followed by J. Tybeck, C. U. Beurling, and A. Kahl. In Swedish history the first place is due to Eric Gustaf Geijer (1783–1847), whose works are models of historic composition. Anders Fryxell (born 1795) and Strinnholm also rank high as historians. Minor historical writers are P. A. Granberg, G. A. Silfverstolpe (1772–1824), J. F. af Lundblad (born 1791), A. Cronholm, A. A. Afzelius, C. G. Styffe, H. Järta, A. I. Arwidsson, F. F. Carlson (born 1811), G. Swederus, and J. Hellstenius. Political literature is chiefly devoted to questions of internal government, and one of its prominent works is a study on "The Swedish Parliament" (*Den Svenska Riksdagen*, 1873) by Rydin; recent publicists and political writers of high reputation are P. E. Svedbom (died 1857) and A. Sohlman (1824–'74), successive editors of the *Aftonbladet*, the most influential journal of the capital, J. A. Hazelius (died 1871), and M. J. Crusenstolpe (1795–1865). The works on Swedish statistics by E. Sidenbladh and C. E. Ljungberg are highly esteemed. The foremost archæologists of the period are N. Sjöborg, J. G. Liljegren (died 1837), A. E. Holmberg, B. E. Hildebrand, H. Hildebrand, Montelius, C. G. Brunius, and R. Dybeck. Works on Swedish literary history have been published by L. Hammarsköld (1785–1827), P. Wieselgren (born 1800), J. E. Rydqvist, J. Lénström, and Ljunggren. The *Biographisk Lexikon*, a biographical dictionary of celebrated Swedes, edited by Palmblad and subsequently by Wieselgren, is in 25 volumes. This is the brightest age in the annals of Swedish poetry. F. M. Franzén (1772–1847) has gained a lasting renown by his naïve and idyllic lyrics. J. O. Wallin (1779–1839) revised in 1819 the Swedish psalm book, a collection of religious verse hardly excelled in modern hymnology, and added 117 psalms by himself and 73 by Franzén, inferior to none in the book. J. D. Valerius, best known by his bacchanalian songs, and J. M. Silfverstolpe (1777–1831), rather a translator than an original poet, both belonged to the earlier part of the century. Two new poetic schools, of vast influence upon polite literature, arose at the beginning of this period, the romantic and the Gothic. The former was represented by the journals *Polyfem* (1810–'12), edited by J. C. Askelöf (1787–1848), and *Fosfores*, whence its members are sometimes styled *Fosforister* or phosphorists. At the head of this school stood P. D. A. Atterbom (1790–1855) as a poet, and Palmblad and Hammarsköld as critics. Atterbom's long poem, *Lycksalighetens Ö* ("The Island of Bliss"), his *Blommorna* ("The Flowers"), and many of his shorter lyrics, are characterized by depth of fancy and feeling. Other *Fosforister* were C. F. Dahlgren (1791–1844), author of *Mollbergs Epistlar*, an imitation of the songs of Bellman; C. E. Fahlcrantz (1790–1866), a successful hu-

morist in his *Noaks Ark*, but less happy in his religious epic, *Ansgarius;* and J. C. Nyberg (Svärdström, born 1785), a female writer of considerable ease and grace, better known as Euphrosyne. The Gothic school, which has left a more permanent impress upon poetry, developed its theories through a society, the *Göthiska Förbund* (the "Gothic Union," 1811), and a journal, *Iduna* (1811–'24). It sought its sources of inspiration in the ancient literature and mythology of the North. Foremost among its members, and foremost among all the poets of Sweden, stands Esaias Tegnér (1782–1846). (See TEGNÉR.) The historian Geijer was another member of the *Göthiska Förbund;* his lyrics are original, strong, and clear. There is more novelty and force than good poetic taste in *Asarne* ("The Gods of the North"), *Tirfing*, and the historical tragedies of P. H. Ling (1776–1839), who is better known out of Sweden as the founder of a new system of medicine or medical gymnastics. Far better in style was C. A. Nicander (1799–1839), author of *Runesvärdet* ("The Runic Sword") and other poems. Influenced by one or other of these two schools, but to a certain extent independent of both, are E. J. Stagnelius (1793–1823), whose dramas, such as *Martyrerna* ("The Martyrs"), epical poems, as *Wladimir*, and minor pieces, are marked by an admirable spirit and great beauty of diction; Erik Sjöberg (1794–1828), better known by his assumed name Vitalis, who, like Nicander and Stagnelius, died early; A. Lindeblad (born 1800), a composer of religious and secular lyrics in the spirit of Tegnér; and A. A. Grafström (1790–1865), whose poetical development was strongly influenced by Franzén. The highest rank among living poets is held by Johan Ludvig Runeberg (born 1804), a native and resident of Finland, in whose *Fänrik Ståls Sägner* ("Ensign Stal's Stories"), a series of patriotic lyrics on the Swedish-Russian war of 1808–'9, are displayed an energy of expression and a depth of poetic thought unknown to Swedish literature since the death of Tegnér. C. W. Böttiger (born 1807), the son-in-law of Tegnér, has written some musical dramas and minor pieces, distinguished by a lively fancy and a cultivated taste. O. P. Sturzen-Becker (1811–'69) wrote lyrics after the manner of Heine, and humorous sketches. Other poets are W. von Braun (1813–'60), whose humor is striking, but too often broad and coarse; Nybom (died 1865); C. W. A. Strandberg, whose pseudonymous name is Talis Qualis, and who has translated Byron and written some lyrics of great excellence; B. E. Malmström (1816–'66), Sätherberg, J. M. Lindblad; Tekla Knös, a poetess, whose claims to fame have been sanctioned by the Swedish academy; G. Silfverstolpe, Wennström, V. E. Norén, Z. Topelius, a Finlander (born 1818), E. Sehlstedt (died 1874), and many others. Charles XV. and his brother and successor Oscar II. are poets of some merit; the latter's translation of Herder's *Cid* has great excellence. Tragedies and historical dramas have been written by J. Börjesson (1790–1866), one of the *Fosforister*, whose *Eric XIV.* is one of the masterpieces of the Swedish drama; C. E. Hylten-Cavallius, Dahlgren, and Kullberg; and comedies by A. Blanche (died 1868), Jolin, Cramér, F. Hedberg (at present the leading writer for the stage), Granlund, Beskow, and others. No romances stand higher than those of three female writers, Fredrika Bremer (died 1865), whose first work (1828) was styled *Teckningar ur Hvardagslifvet* ("Sketches of Every-Day Life"); E. S. Carlén (born 1807), a prolific and popular authoress of novels of society; and Baroness Knorring (died 1833). All of these are widely known both in Europe and America through numerous translations. Of the imitators of Sir Walter Scott, the highest name is perhaps the learned and versatile V. F. Palmblad (1788–1852), celebrated as a geographer, critic, biographer, and politician of the ultra conservative school, whose *Aurora Königsmark* was one of the earliest readable fictions in Swedish. Equally versatile was C. J. L. Almquist (1793–1866), whose tales, and especially a collection called *Törnrosens Bok*, are rich in variety and fancy. Other romancers are Count P. G. Sparre (born 1790); F. Cederborg (born 1784), author of *Ottar Tralling* and *Uno von Trasenberg*, historical fictions of much interest; C. F. Ridderstad (born 1807), an imitator of the Dumas school; Kjellman-Göransson, Zeipel, Bjursten, O. P. Sturzen-Becker; C. A. Wetterberg (born 1804), a popular writer of sketches and tales under the assumed name of Onkel Adam; G. H. Mellin (born 1803); and Viktor Rydberg, statesman, metaphysician, and essayist, who has produced at least one powerful work of fiction, *Den siste Atenaven* ("The last Athenian"). Claude Gérard (a pseudonyme) and Mrs. M. S. Schwartz (born 1819) enjoy at present the greatest popularity as novelists. As translators may be mentioned C. A. Hagberg, author of an accurate and spirited version of the complete works of Shakespeare; Andersson, translator of Goethe; and N. Lovén, who has rendered the poems of Dante and Camoens into Swedish verse. Most of the higher efforts of literature in English, French, German, Italian, and Danish, especially in fiction, have been translated within the last 30 years. Sweden supports 271 newspapers, one of which, *Svenska Veckobladet*, has a circulation of 50,000 copies. On the whole the last 15 years has been a period rather of political than of literary activity, yielding comparatively few works of high æsthetical value.

**SWEDENBORG, Emanuel**, a Swedish philosopher, born in Stockholm, Jan. 29, 1688, died in London, England, March 29, 1772. He was the son of Jesper Swedberg, bishop of Skara (see SWEDBERG), the name being changed to Swedenborg in 1719 on the occasion of the ennobling of the family. This advancement enti-

tled him, as head of the family, to a seat in the house of nobles of the Swedish diet, but did not confer the title of baron, as has been supposed. Emanuel was educated at Upsal, completing his studies in 1709. After two years of travel in England, Holland, and France, he went to reside at Greifswald in Pomerania, then a Swedish town, and busied himself with scientific research. He also wrote some Latin fables, which were published under the title of *Camena Borea.* A collection of Latin poems, written by him during his travels, was also published about the same time in a volume entitled *Ludus Heliconius.* In 1716 he returned to Sweden and established a periodical called *Dædalus Hyperboreus*, devoted to mathematics and mechanics, which appeared irregularly for two years. During this time he had become intimate with Christopher Polhem, an eminent engineer, and Polhem introduced him to Charles XII., who appointed him assessor extraordinary of the college of mines, and associate engineer with Polhem. For two years Swedenborg maintained close personal relations with the king, and assisted him much in his military operations. During the siege of Frederickshald, at which Charles met his death, Swedenborg constructed, under Polhem's direction, the machines by which several vessels were transported overland from Strömstad to the Iddefiord, 14 miles. At the king's suggestion, it is said, Polhem betrothed his daughter to Swedenborg; but as the young lady preferred another man, Swedenborg relinquished his claim and never married. From 1717 to 1722 he published pamphlets on scientific subjects; among them one describing a method of determining longitude by means of the moon. In 1721 he made a short tour on the continent, visiting mines and smelting works. On his return in 1722 he was promoted to be full assessor of mines, and for the next 12 years he devoted himself to the duties of that office, refusing the professorship of mathematics at Upsal in 1724. In 1734 he published *Opera Philosophica et Mineralia* in three large folio volumes, illustrated with numerous plates, viz.: vol. i., *Principia;* vol. ii., *De Ferro;* vol. iii., *De Cupro et Orichalco.* In the same year also appeared his *Prodromus de Infinito.* In 1736 he began another tour of travel, which, with study and writing, occupied him for several years. In 1740–'41 he published his *Œconomia Regni Animalis*, in two parts, and in 1744–'5 his *Regnum Animale*, in three parts. Between 1729 and 1741 he was elected successively a member of the academy of sciences at Upsal, corresponding member of the imperial academy of sciences at St. Petersburg, and member of the academy of sciences at Stockholm. His series of scientific publications ended in 1745 with the treatise *De Cultu et Amore Dei*, &c., in which is set forth, under the form of a prose poem or allegory, his theory of the process of creation. Thereafter, as he says, he was called by God to the work of revealing to men a new system of religious truth. For that end he was permitted to converse with spirits and angels, and behold the wonders of the spiritual world. That he might be more free to perform his task, he resigned his assessorship, retaining half the salary by way of pension. He devoted himself first to the study of the Bible in the original, and then to the writing of books explanatory of his new doctrines, which were published entirely at his own expense. From 1749 to 1756 appeared the *Arcana Cœlestia* (8 vols. 4to), containing a commentary on Genesis and Exodus, interspersed with accounts of "wonderful things seen and heard in heaven and in hell." This was followed in 1758 by the *De Cœlo et Inferno*, *De Telluribus in Mundo*, *De Ultimo Judicio*, *De Nova Hierosolyma*, and *De Equo Albo.* In 1763 were published the four doctrinal treatises: *Doctrina Vitæ*, *De Fide*, *De Domino*, and *De Scriptura Sacra*, with a *Continuatio de Ultimo Judicio*, and the treatise *De Divino Amore et de Divina Sapientia.* In 1764, the *Divina Providentia* appeared; in 1766, the *Apocalypsis Revelata;* in 1768, *De Amore Conjugiali;* in 1769, *Summaria Expositio Doctrinæ* and *De Commercio Animæ et Corporis;* and in 1771, the *Vera Christiana Religio.* Besides these, he left at his death an immense mass of manuscripts, of which the following have been since printed: *Itinerarium*, *Clavis Hieroglyphica*, *Opuscula*, *Apocalypsis Explicata*, *Adversaria in Libros Veteris Testamenti*, *Diarium Spirituale*, *Index Biblicus*, *Sensus Internus Prophetarum et Psalmorum*, *Dicta Probantia*, *De Athanasio Symbolo*, *De Charitate*, *Canones*, *Coronis Veræ Christianæ Religionis*, and *Invitatio ad Novam Ecclesiam.* Copies of a few of these manuscripts have recently been reproduced by the photolithographic process, by subscription, not so much for circulation as for the sake of preserving the contents of the originals from destruction by decay.—Swedenborg's manner of life was simple and modest. He spent much of his time, in later years, in Holland and England, for which countries he expressed great admiration on account of the freedom of speech and writing permitted there. He made no efforts to gain proselytes to his doctrines further than by printing and distributing his writings, and never referred to his intercourse with the spiritual world except when questioned. Several instances are reported of his obtaining information from departed souls respecting affairs unknown even to their families, and describing events in distant places in advance of news by the ordinary means of communication. It is related that, as he lay on his deathbed in London, Ferelius, a Swedish clergyman, solemnly adjured him to tell the truth in regard to his teachings. Swedenborg raised himself half upright in bed, and placing his hand on his breast said with emphasis: "As true as you see me before you, so true is everything I have written. I could have said

more had I been permitted. When you come into eternity, you will see all things as I have stated and described them, and we shall have much to say concerning them to each other." He then received the holy supper from Ferelius, and presented him with a copy of his *Arcana Cœlestia.* A day or two afterward he peacefully breathed his last. His body was buried in a vault of the Swedish church in Prince's square, a little east of the tower. A eulogium was pronounced upon him in the Swedish house of nobles in October, 1772, by Samuel Sandels, which accords him high praise, not merely for learning and talent, but also for uprightness and fidelity in the discharge of his duties as a public functionary. Several of his acquaintances have also left written testimony to his virtuous character.—Swedenborg's scientific works have long since ceased to be of practical value, but are still highly interesting as collections of facts, and as exhibiting their author's peculiar method of philosophizing. The system he followed was substantially that of Descartes, of whom he continued to the end of his life to speak with admiration, and this led him to conclusions resembling in some striking points those of Spinoza, who was likewise a Cartesian. His "Economy of the Animal Kingdom" is the best of his many productions anterior to his theological career. In it he attempts to deduce a knowledge of the soul from an anatomical and physiological knowledge of the body, and evolves many doctrines which he afterward elaborated in his theological works. Indeed, some of his disciples hold that his seership was the natural result of his intellectual and moral development, and by no means an abnormal condition of mind. According to his own account, it came upon him gradually, and neither astonished nor alarmed him, although in its early stages he was subject to great mental excitement, the phenomena of which may have given rise to exaggerated stories of his insanity. The works written by him subsequent to this change in his mind are quite as systematic and coherent as his earlier productions, and only his claim to a divine mission, and his frequent descriptions of what he saw and heard in the spiritual world, mark them as peculiar. They are consistent from first to last, and though they appeared at intervals during a period of 27 years, they nowhere deviate from the fundamental principles laid down at the outset.—The general features of Swedenborg's theology are presented in his treatise called the "True Christian Religion." He teaches that God is one in essence and in person, and has been revealed to men as the Lord Jesus Christ. In the Lord is a trinity, not of persons but of principles, and it is these principles which are spoken of in the Scriptures as Father, Son, and Holy Ghost. The Father is the divine love, the Son the divine wisdom, and the Holy Ghost the divine operation or energy acting upon the universe. The Lord is infinite, eternal, self-existent, omnipresent, omniscient, and omnipotent, and not only the creator but the sustainer of all creation, which without him would cease to exist. For the sake of redeeming mankind he assumed a natural body born of the Virgin Mary, and glorified it or made it divine, so that it is now invisible to men, and also usually to the angels except as the sun of heaven. Redemption consisted, not in suffering vicariously the punishment of men's sins (for that could not be done, and, if it could, would be useless), but in actual combats, by means of the assumed humanity, with the powers of hell, and overcoming them. This victory restored to man spiritual freedom, which had begun to be impaired by diabolic possessions as narrated in the Gospels, and enabled him to work out his salvation. This he does by looking to the Lord, with faith in him, by repentance, and above all by a life according to the commandments of the decalogue. The chief points that Swedenborg insists on in religion are faith in the Lord and the avoidance of evils as sins against him. Upon everything else, such as outward worship, prayer and meditation, and works of eleemosynary charity, he lays but little stress. The essence of charity is love to the neighbor and occupation in some useful employment. The Word, he says, is the divine truth itself, written to reveal the Lord to man and to serve as a medium of conjunction between earth and heaven. This Word consists of the books of Genesis, Exodus, Numbers, Deuteronomy, Leviticus, Joshua, Judges, Samuel, Kings, the Psalms, the prophecies, the four Gospels, and the Apocalypse. The other books bound up with these in our Bibles are not the Word, although good and useful to the church. The distinction between the two consists in this: that the Word contains an internal or spiritual sense, which the rest of the Bible has not. This spiritual sense is symbolical, and may be discerned by the application of the law of symbolism resulting from the universal correspondence of natural with spiritual things. Thus, the garden of Eden and all things mentioned as existing in it symbolize the human soul and its affections and thoughts; and the disobedience of Adam and Eve, the alienation of mankind at a remote period from their original state of innocence. Hence, too, the decalogue forbids not merely outward sins, but the inward spiritual sins corresponding to them, and the Psalms and prophecies relate not merely to David and the Jews, but to experiences of the human soul independent of dates and localities. At the same time the literal sense alone can be relied on as a basis of doctrine, and Swedenborg is careful to cite it profusely in support of his teachings. The reason he gives for his mission is that the knowledge of true doctrine had been lost and the church destroyed by a false theology and accompanying evils of life. By the promulgation of the

truth revealed to him a new church has been established by the Lord, and thus the prophecies in the Apocalypse of the descent of the New Jerusalem have been fulfilled in their symbolical sense. The second coming of the Lord, predicted in Matt. xxiv., has also been accomplished in the same way, a last judgment having been effected in the spiritual world in the year 1757, so that we are now living under a new dispensation. The treatise on "Heaven and Hell" embodies Swedenborg's teachings on the nature of those two realms, and their relations to this world. They exist, he says, not in some other region of space, but within the natural world, as the soul of man exists within his body, being in fact in the souls of men and resting in them as our souls rest in our bodies. At death the body, which is the material envelope of the soul, is cast aside, never to be resumed, and consequently its resurrection is not to be looked for. The soul is the man himself, and is a perfect human being, with a spiritual body of its own, and rises into a conscious perception of the spiritual world, of which the man had previously been unconsciously an inhabitant. He sees and feels and possesses all the other senses, and retains all his personal characteristics. After a longer or shorter preparation in an intermediate state called the world of spirits, which lies between heaven and hell, he is drawn by his own elective affinity to the place where he belongs, and remains there to eternity. Both heaven and hell consist of innumerable societies, each composed of human beings of similar and concordant affections; and both are divided into three distinct regions, according to the degrees of perfection or depravity of their inhabitants. The *Arcana Cœlestia*, Swedenborg's largest work, is mainly an exposition of the internal or symbolical sense of Genesis and Exodus, with accounts of his experiences in the spiritual world, and various doctrinal teachings interspersed between the chapters. "The Apocalypse Revealed" and "The Apocalypse Explained" are similar expositions of the Apocalypse. In his "Conjugial Love" Swedenborg expounds his doctrine of the relations of the sexes. Males, he says, are masculine and females feminine in soul as well as in body. The masculine element is love clothed with wisdom, while the feminine is wisdom clothed with love. Hence the characteristic of man is wisdom or understanding, and that of woman love or affection. Marriage is the conjunction of two souls who complement each other, and by their union make one complete being, just as the will and the understanding make the individual. Hence the only true marriage is of one man and one woman, and it exists in the next world as well as in this. Polygamy is a degraded state, but not a sin with those whose religion permits it; but adultery is destructive of the life of the soul, and closes heaven against those who confirm themselves in it. The treatises on the "Divine Love and Wisdom" and the "Divine Providence" embody Swedenborg's spiritual philosophy, and exhibit the symmetrical relations of the various parts of his religious system. Love, he says, is the life of man. God alone is Love itself and Life itself, and angels and men are but recipients of life from him. He is very Man, and our humanity is derived from him, so that it is literally true that we are created in his image and likeness. His infinite love clothes itself with infinite wisdom and manifests itself in ceaseless operation, producing, maintaining, and reproducing the boundless universe, with all its innumerable parts and inhabitants. In like manner men, being made in the image of God, also have love or the will, and wisdom or the understanding, and the two produce in them their finite operation. It being the nature of love to desire objects upon which to exercise itself, God could not but create the universe. The creation of this and other solar systems, all of which are inhabited, was effected by a spiritual sun, which is the first emanation proceeding from God, and which is seen in the spiritual world as our sun is seen by us. By means of this spiritual sun natural suns were created, and from them atmospheres, waters, earths, plants, animals, and finally man. Angels, spirits, and devils are men who have been born and died on this or some similar planet. Hence, all things were created from God, and not out of nothing. The spiritual world is related to the natural as cause is to effect, and the supreme first cause of all is God himself. These three, end, cause, and effect, constitute three distinct or discrete degrees, which are repeated in various forms in all created things, and on a grand scale in the universe as a whole. Creation, being from God, is, like the individual man, an image of him, and hence is in the human form in its greatest and least parts, and with more or less approximation to perfection. As we are finitely men, because God is an infinite Man, so all animals, plants, and even minerals wear a resemblance to man, and throughout all nature there is an incessant effort to evolve the human form. In the sight of God and the angels, larger and smaller bodies of human beings and the societies of heaven and hell appear organized like men, and Swedenborg calls the universe the Grand Man (*Maximus Homo*). As infinite love was the end and infinite wisdom the cause of creation, so the divine life and power are constantly active in sustaining and directing it. This activity is the Divine Providence, and it reaches to every smallest particular of nature and humanity. Man has freedom, because without it he could not be an adequate recipient of the divine love, and by the abuse of his freedom he has introduced evil into the world. The Divine Providence seeks, without destroying this freedom, to lead man back to his original integrity. Hence all the wonderful dealings of God with man recorded in the Scriptures;

hence the incarnation; and hence the various forms of religion which exist in the world, all of which embody more or less the essentials of salvation, namely, the worship of God and abstinence from evils as sins against him. The smaller treatises of Swedenborg are mostly extracts from his larger works, with amplifications and additions.—The fullest account of him and his writings is that of William White (2 vols., London, 1867, since republished in one volume). See, also, "Documents concerning Swedenborg," by R. L. Tafel (London, 1875 *et seq.*). All of his theological and some of his scientific works have been translated into English. The theological works have also been reprinted in Latin by Dr. J. F. I. Tafel, of Tübingen, Germany, and partially translated and published in French, German, Italian, Danish, and Swedish. Societies for promoting their circulation are in operation both in the United States and in Europe. The principal writers who have undertaken the exposition of Swedenborg's doctrines in England are John Clowes, Robert Hindmarsh, C. A. Tulk, Samuel Noble, J. J. G. Wilkinson, and Jonathan Bayley; in France, E. Richer and J. F. Les Boys-des-Guays; and in the United States, George Bush, Theophilus Parsons, E. H. Sears, Henry James, B. F. Barrett, W. B. Hayden, and Chauncey Giles. For an account of the ecclesiastical organization based upon Swedenborg's doctrines, see New Jerusalem.

**SWEET BRIER.** See Eglantine.

**SWEET GUM.** See Liquidambar.

**SWEET POTATO.** See Potato, Sweet.

**SWEETWATER,** a central county of Wyoming, extending across the territory from Montana on the north to Colorado and Utah on the south; area, about 35,000 sq. m.; pop. in 1870, 1,916. It is crossed by the Wind River and Rocky mountains, and is watered in the north by the Big Horn river and its head streams, and in the south by the Sweetwater and Green rivers. It contains deposits of coal and gold. The S. part is crossed by the Union Pacific railroad. In 1870 there were 3 saw mills and 4 quartz mills. Capital, South Pass City.

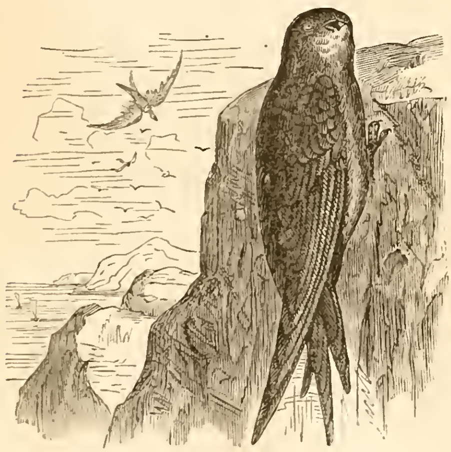
**SWEET WILLIAM.** See Pink.

**SWETCHINE, or Svetchin, Anne Sophie,** a French writer, born in Moscow in 1782, died in Paris, Sept. 10, 1857. She was the granddaughter of Gen. Boltin, a translator of the *Encyclopédie* into Russian, and daughter of Soimonoff, one of the founders of the academy of sciences at Moscow, and private secretary to Catharine II., at whose court she was brought up. In 1799 she married Gen. Svetchin (born in 1758, died Nov. 23, 1850) to please her father, who was banished from St. Petersburg and died soon afterward at Moscow. Her mother having died, the education of her younger sister (the future princess Gregory Gagarin) devolved upon her, in addition to that of her husband's adopted daughter. At the same time she gathered round her the most eminent Russians and French emigrants, who cultivated her society even after the sudden removal in 1801 of her husband from his offices as military commandant and provisional governor of St. Petersburg. Her delicate health and her sorrow for the loss of her father increased her proneness to religious meditation, which was still further developed by her filial relations with the count Joseph de Maistre, French ambassador at the Russian court, although her final conversion in 1815 to Roman Catholicism was more directly ascribed to the writings of the abbé Fleury. As soon as the proscriptive measures against the Jesuits were announced, she publicly avowed her change of religion; and as it was feared that her ascendancy over the emperor Alexander might become as great as that of Mme. Krüdener, she was compelled to depart from Russia by vexatious proceedings against her husband on this and subsequent occasions. She spent the winter of 1816–'17 in Paris. In 1818 she and her husband were at St. Petersburg, and she never returned again to Russia excepting once about 12 years later. After spending several years in Italy, she settled permanently in Paris in 1825. De Falloux, her literary executor, has published *Mme. Swetchine, sa vie et ses œuvres* (2 vols., 1859, vol. ii. comprising her *Pensées*, &c.); her *Lettres* (2 vols., 1862); *Journal de sa conversion* (1863); and *Lettres inédites* (1866). Harriet W. Preston has translated the "Life and Letters of Madame Swetchine" (Boston, 1867; 8th ed., 1875), and "The Writings of Madame Swetchine" (1869). See also Mme. Swetchine's correspondence with Lacordaire (Paris, 1864), and with Lagrange (1875).

**SWIETEN, Gerard van,** a Dutch physician, born in Leyden, May 7, 1700, died in Schönbrunn, Austria, June 18, 1772. He was a favorite pupil of Boerhaave, and after a few years' practice became professor of medicine at Leyden; but on account of his adherence to the Roman Catholic faith he was compelled to resign. In 1745 he went to Vienna as physician-in-chief to the empress Maria Theresa, and professor of medicine and anatomy; and he held several other important offices there. His great medical work, *Commentarii in H. Boerhaavii Aphorismos de Cognoscendis et Curandis Morbis* (5 vols. 4to, Leyden, 1741–'72), was translated into German, English, and French.

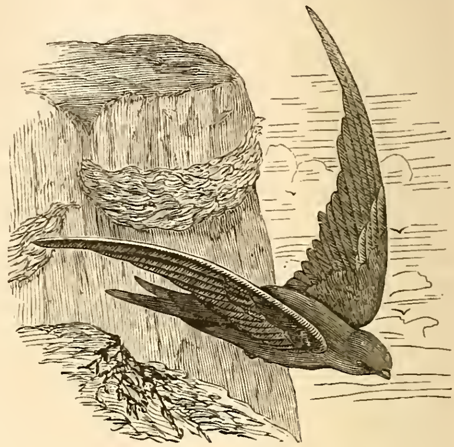
**SWIFT,** the general name of the *cypselidæ*, a subfamily of birds formerly placed among the swallows, but by modern ornithologists ranked as a separate family coming near the humming birds, on account of certain anatomical peculiarities, and particularly of the absence of singing muscles in the lower larynx. The swifts resemble the swallows in habits and in their general form; the bill is more suddenly curved, unprovided with bristles at the base; nostrils very large, oblong, with an elevated margin; wings extremely long, curved and narrow, with ten primaries; tarsi short and weak, and more or less feathered; toes short and thick, and all four are or may be directed forward; claws

strong and curved; ten feathers in the tail. They are very swift and graceful fliers, feeding exclusively on insects, which they capture on the wing; they are migratory like the swallows, but do not mingle with them and are less hardy; most of them nestle in hollow trees, holes in buildings, or crevices in rocks; some species rear two or three broods in a season.—In the genus *cypselus* (Illig.) the second quill is the longest, and the tarsi are feathered to the base of the toes; it is peculiar to the old world. The common European swift or black martin (*C. apus*, Illig.) is $7\frac{1}{2}$ in. long, with a forked tail; it is blackish brown above with a green gloss, and the throat grayish white. It appears in Great Britain in May, departing in August. The extreme shortness of the legs renders walking and rising from a flat surface almost impossible, but the stout toes and sharp claws form admirable clinging organs for climbing in and out the holes where the nests are placed. The white-bellied swift (*C. melba*, Illig.) is $8\frac{1}{2}$ in. long, grayish brown above and white below, the legs covered with brown feathers; it is common in southern Europe, especially in mountainous regions.—In the genus *chætura* (Steph.) or *acanthylis* (Boie) the tail is very short, about two fifths of the wings, slightly rounded, the shafts stiffened and extending beyond the feathers as rigid spines; first quill the longest; legs covered with a naked skin. The species are found in North and South America, Australia, and the East Indies; they live in flocks, and breed usually in holes of trees, but sometimes in crevices



White-bellied Swift (Cypselus melba).

in rocks, and the eggs are usually four. The American swift or chimney swallow (*C. pelagica*, Baird) is $5\frac{1}{4}$ in. long and $12\frac{1}{3}$ in. in alar extent; it is sooty brown above with a greenish tinge, a little paler on the rump, and considerably lighter from the bill to the breast; it is found from the eastern states to the slopes of the Rocky mountains, arriving from the south by the end of April or beginning of May, and departing during the first half of September. This species naturally makes its nest in hollow trees, but in the neighborhood of man builds in such chimneys as are not used in summer for fires; the nest is made of twigs snapped off from a dead tree during flight, fastened together by viscid saliva, without soft



Esculent Swift (Collocalia esculenta).

lining, and is generally placed from 5 to 8 ft. from the entrance; the eggs are pure white. They pass in and out the chimney with great rapidity, making a whirring sound like distant thunder; there are sometimes 200 in a single chimney.—In the genus *collocalia* (Gray) the bill is very small, wings very long, tail moderate and nearly even, and tarsi naked. The esculent swift or swallow (*C.* [*hirundo*] *esculenta*, Gray) is the principal maker of the celebrated nests so highly esteemed by the Chinese as articles of food. (See Birds' Nest, Edible.) The eggs are two in this genus. There are many other species of swifts, both in the old world and the new.

**SWIFT,** a W. county of Minnesota, bordering S. W. on the Minnesota river, and intersected by the Chippewa and Pomme de Terre rivers; area, about 750 sq. m. It has been formed since the census of 1870. The surface is rolling, with numerous small lakes; the soil is good. The St. Paul and Pacific railroad traverses the county. Capital, Benson.

**SWIFT, Jonathan,** a British author, born in Dublin, Nov. 30, 1667, died there, Oct. 19, 1745. He was of purely English descent; his father, dying before the birth of his son, left his family in dependent circumstances. In his 15th year he entered Trinity college, Dublin, where from his insufficiency in some respects he received his bachelor's degree only *speciali gratia*, in February, 1685; but he remained in college studying for a master's degree till the revolution of 1689 drove him to England, where he became private secretary to Sir Wil-

liam Temple, whose wife was related to his mother. He employed his leisure hours in study, and acquired a remarkable familiarity with public affairs. In 1692 Swift took his master's degree at Oxford, and two years later, finding Temple unwilling to make any definite provision for him, he went to Ireland. In October, 1694, he was ordained, and soon after received the prebend of Kilroot, in the diocese of Connor; but in a few months he returned to his secretaryship. Temple, dying in January, 1699, left him a legacy, coupled with the task of editing his posthumous works (London, 1699). Swift next became chaplain to Lord Berkeley, one of the lords justices of Ireland, whom in 1699 he accompanied to Dublin, acting as his secretary during the journey. He was supplanted in the secretaryship by a person who subsequently interfered so that the rich deanery of Derry, at Berkeley's disposal, and to which Swift deemed himself entitled, was given to another. Swift exclaimed to the earl and his secretary, "Confound you both for a couple of scoundrels!" and left the castle. But he soon came back, the new dean of Derry (Dr. Bolton) being required to resign to him the vicarage of Laracor and several other livings, amounting altogether to nearly £400 a year. In 1700 Swift assumed his parochial duties at Laracor, and shortly after received the prebend of Dunlavin in St. Patrick's cathedral, Dublin, and in February following took his doctor's degree in Dublin university. In 1701 he made the first of a number of annual visits to England, and published anonymously in London his "Discourse on the Contests and Dissensions between the Nobles and Commons of Athens and Rome," vindicating the conduct of the whig leaders, Somers, Halifax, Harley, and Portland, in respect to the partition treaty. It was generally attributed to Somers himself or Burnet; but Swift avowed the authorship in the succeeding year, and was immediately admitted into the society of the statesmen he had defended, and into that of Addison, Steele, Arbuthnot, and others of the leading wits of the time. Some trifles in prose and verse had shown an original vein of humor, but he had signally failed in a series of "Pindaric Odes." In 1704 appeared his "Battle of the Books," written at Moor Park in 1697, in support of Sir William Temple's views in the controversy respecting the relative merits of ancient and modern learning. This was succeeded by the "Tale of a Tub," a satire upon the Roman Catholics and dissenters. It is one of Swift's most perfect and labored efforts, but its imputed irreligious tendency proved an insurmountable obstacle to his hopes of high preferment. In 1708 he published his "Argument to prove the Inconvenience of Abolishing Christianity," a masterpiece of grave irony; "Sentiments of a Church of England Man with respect to Religion and Government;" the humorous attacks on Partridge the almanac maker, entitled "Predictions for 1708, by Isaac Bickerstaff;" and "Letters on the Sacramental Test," in which he differed with the whigs, and this may partially explain his subsequent abandonment of that party. In 1709 he published the only work to which he ever attached his name, "A Project for the Advancement of Religion and the Reformation of Manners." Failing to receive preferment from the whigs, he went over to the tories in October, 1710; and for several months the "Examiner," a weekly paper established by St. John and others in the interest of the ministry, was the vehicle for bitter attacks from his pen upon prominent whig statesmen. About this time he formed the society of Brothers, composed of 16 influential tories, of which he was the most active member. His powerful pamphlet on the "Conduct of the Allies," published in November, 1711, which had a considerable influence in bringing the war to a close, raised his reputation to the highest pitch, and he found himself in a position to confer substantial favors. But he himself, while dictating, as Dr. Johnson has observed, the political opinions of the English nation, remained unrewarded; and the efforts of Harley and St. John, now become Lords Oxford and Bolingbroke, aided by Mrs. Masham, were unavailing to procure him a bishopric, the queen, under the advice of Archbishop Sharp and other prelates, positively refusing him any high preferment. On the failure of an application in his behalf for the vacant see of Hereford, through the opposition of the duchess of Somerset, whom he had lampooned, Swift threatened to withdraw his support from the ministry, but was pacified by his appointment, in February, 1713, to the deanery of St. Patrick's cathedral, Dublin, the income of which amounted to £700. He had scarcely got settled in his deanery when he was summoned back to England to reconcile the difficulties between Oxford and Bolingbroke. About this time he wrote his "Public Spirit of the Whigs," which reflected so bitterly upon the Scottish nation and nobility that the latter in a body presented a complaint to the queen. In June, 1714, appeared his "Free Thoughts on the State of Public Affairs;" and on the dismissal of Oxford a few weeks later he declined the flattering overtures of Bolingbroke, in order to be of service to the disgraced minister. The death of the queen immediately after this event and the overthrow of the tories sent Swift back to Ireland, where he remained during the next 12 years.—Swift's history was painfully involved with that of three young ladies. One was Miss Jane Waring, sister of a college friend, of whom he became enamored in Belfast; he called her Varina. His offer of marriage she at first declined on account of her own ill health and his insufficient income; and the hopelessness of settling differences on both sides led to a cessation of their intercourse. While secretary for Sir William Temple, Swift had con-

ceived a strong friendship for Esther Johnson, daughter of a woman who was for many years an attendant upon Temple's sister, Lady Giffard. Swift's account of Esther is that "her father was a younger brother of a good family in Nottinghamshire, her mother of a lower degree." Swift on his first settlement in Ireland invited this young lady (named Stella in his poems) to Laracor, and with a friend, Mrs. Dingley, she came and resided near him. They were intimate, saw each other often, and corresponded when apart; and she attended to his household in his absence. Subsequently, in London, he became acquainted with Hester Vanhomrigh, a spirited, intelligent, and accomplished girl, whom he kindly noticed and aided in her studies. She conceived for him a passion so earnest that she proposed marriage, which he declined, but without discouraging her advances; and after the death of her mother she went to Ireland (1714) to dwell in his vicinity. Vanessa (the name he gave her), ignorant for a time of his relations to Stella, endured his coldness with hope of a favorable change, till in 1717 she retired with her sister to Marley abbey to live in deep seclusion. Meantime Stella urged her claims, and won his consent under the stipulation of perpetual secrecy; and they were married privately in the garden of the deanery in 1716. Their relations had been, and because of this secrecy continued to be, equivocal. Vanessa's sister being ill, Swift several times visited the abbey; but receiving no other encouragement, and tormented by suspicion and impatience, Vanessa wrote to Stella to ascertain the nature of her intimacy with Swift. The dean, getting possession of the letter, rode directly to Marley abbey, flung it upon the table before Vanessa with a frown which struck her dumb with terror, and instantly departed. The unhappy woman survived this shock but a few weeks, and Swift, overcome by shame and remorse, retired for two months to solitude in the south of Ireland. After her death appeared his poem "Cadenus and Vanessa," describing the manner in which Swift (personified as Cadenus, an anagram of *Decanus*, the dean) received the early advances of Miss Vanhomrigh. Five years later Stella herself died, without any public recognition of her marriage.—Swift produced in 1720 "A Defence of English Commodities, being an Answer to the Proposal for the Universal Use of Irish Manufactures," followed in 1724 by the celebrated "Drapier's Letters," in opposition to the royal grant authorizing Wood to coin £108,000 in halfpence and farthings for general circulation in Ireland. The author denounced the whole system of government in Ireland with a vigor and point which aroused a powerful popular feeling in his favor. His effigy was produced on signs and medals, and distributed broadcast in innumerable prints; and so powerful became his influence with the lower classes that Walpole, when meditating legal proceedings against him, was told that it would require 10,000 men to arrest him. In 1726 appeared his "Gulliver's Travels," a series of satires on human nature and society, the most original and extraordinary of all his productions, and that by which he will be known while the language lasts. In 1726 and 1727 he made visits to England, renewing his intimacy with Pope, Gay, Bolingbroke, Arbuthnot, and others of his early friends; but after the death of Stella he never left Ireland. For several years he wrote with vigor and increasing bitterness on Irish affairs, and amused himself with composing verses, the humor of which is more than equalled by the fierceness and obscenity of the satire; but by 1736 his health became so undermined by frequently recurring attacks of deafness and vertigo, to which he had been subject from an early age, as to preclude further literary labors. His infirmities rapidly increased after this, and in a corresponding degree his memory and intellect decayed. In the latter part of 1740 his memory almost entirely left him, and frequent fits of passion at length terminated in furious lunacy. This subsided in 1742, and he passed the last three years of his life in a condition of speechless torpor. He was interred in the cathedral, amid extravagant demonstrations of popular respect. He bequeathed the bulk of his property, amounting to £10,000, to found a hospital for insane persons. Swift was tall and well made, with a swarthy complexion, and a cast of face that would have been heavy but for the pleasing expression of his eyes.—Some posthumous works of Swift were published long after his death, including "A History of the four last Years of Queen Anne;" "Polite Conversation," a satire on the frivolities of fashionable life; and "Directions for Servants." A complete edition of his writings was published in 19 vols. by Sir Walter Scott, whose biography of him is still the standard one. That by Dr. Johnson, in his "Lives of the Poets," reflects too closely the dislike which the biographer always entertained for Swift. There is also a copious life by Thomas Sheridan, and an account of his latter years by Dr. Wilde of Dublin, written on the occasion of the remains of Swift and Stella being exhumed, during some repairs in St. Patrick's cathedral, in 1835. The character of Swift is the subject of an elaborate essay by Thackeray, included in his "British Humorists." John Forster's "Life of Jonathan Swift" (vol. i., 1875) was unfinished at his death.

**SWIFT, Lewis.** See p. 904.

**SWIMMING,** the art of keeping the body afloat and propelling it by means of the hands and feet. The swimming of man is artificial, but as the specific gravity of the human body is very little greater than that of water, it can be floated with little difficulty. The support is greatly increased by propulsion, just as a thin flat stone is prevented from sinking by

projecting it with force against the surface of the water. In learning to swim, the first essential is confidence; the pupil then learns to keep the body afloat; and when he knows how to apply the extremities to the water with a view to propulsion he can swim. Confidence is best assured in this way: Let the pupil wade out breast deep, face about, and toss an egg or a white pebble into the water between himself and the shore and plunge after it. In struggling to reach it he will find himself buoyed up by the water, and will learn that it is easier to swim than to sink. This was Dr. Franklin's suggestion, and the most recent manuals recommend it. Some teachers inspire confidence and at the same time teach the propulsory movements by holding the pupil on the flat of the hand and then removing the support, leaving him to float and propel himself. The use of corks, bladders, and life preservers retards instruction, and is now nearly obsolete. The pupil learns first to swim on the chest. He assumes as nearly as he can a horizontal position, with the breast prone to the water and the heels as near as possible to the surface. To effect propulsion, the arms and legs are simultaneously flexed and drawn slowly toward the body, and then are simultaneously and rapidly extended. The two hands should be kept flat, the fingers closed, the thumb placed by the side of the first finger, and the pupil should reach forward with his hands as far as he can, for the farther forward he reaches the faster will he swim. He then draws both legs well up, and while each hand is brought around, one to the right and the other to the left, he strikes out simultaneously and strongly with his legs. The secret of a good stroke is to kick out with the legs wide apart. The propelling power is secured by the legs being brought from a position in which they are placed wide apart to one in which they are close together like the blades of a pair of scissors. In this position the heels should touch each other, and in drawing up the legs the toes should be pointed backward to avoid the resistance of the water against the insteps. It is a fallacy to suppose that the speed of the swimmer in any degree depends upon the resistance of the water against the soles, or that large flat feet are aids, unless it may be in treading water. Breast swimming is the commonest and easiest method, and the only one possible for long distances. But the prone position of the body presents a large resisting surface; the arms and legs are spread out on either side of the trunk, and so are applied but partially as propellers, the most effective part of the stroke corresponding say to a quarter of an ellipse, while the remaining three quarters are devoted to getting the arms and legs into position, which wastes power and increases friction. To obviate these difficulties, scientific swimmers have recently adopted the side stroke. The swimmer throws himself on the left side (a good swimmer on either side), and advances the left arm in a curve, making it act as a cutwater, while the right arm directed downward and backward and the legs make a powerful stroke. The right arm and legs thus give three limbs moving simultaneously in the same direction, the left arm always moving in an opposite direction. The right arm and legs are flexed and carried forward while the left arm is forced backward, and *vice versa*. The strong backward stroke of the three limbs gives a powerful forward impulse, and as the body is on the side, as on a keel, the resistance is much reduced. The overhand stroke is similar, only in reaching forward the arm is brought out of the water, and the swimmer, advancing the right and left sides of the body alternately, secures greater continuity of motion and materially reduces the friction. Both these methods are much faster but more exhausting than breast swimming, and are practicable only for short distances, in saving life and in races. The speed attained by these strokes is indicated by the recent record of professional swimmers in London; in baths 400 yards have been swum in 5 m. 10 sec., 500 in 7 m. 27 sec., and 1,000 in the Serpentine in 16 m. 43 sec. With a strong favoring tide in the Thames a mile has been swum in 11 m. 43 sec., two in 23 m. 13 sec., three in 35 m. 23 sec., four in 48 m. 19 sec., and five in 64 m. 23 sec. Swimming on the back is more easily learned than breast swimming, and the body being more nearly horizontal, it is not difficult to swim by using the legs only, with the arms folded over the chest. In treading water, the swimmer's body is in an upright position, with the head well out, and a rapid movement of the feet as in ascending steps is the sustaining and propelling power; the hands may be out of the water or may be used to assist in propulsion. Both these methods are reliefs in long swims. In diving, the hands are brought together in front to cleave the water and protect the head, and the legs are kept straight, the heels touching each other. If the diver desires to come almost instantly to the surface again, he has only to direct his hands upward above his head. To float on the back, the swimmer suffers the back of the head to be submerged, the face only being above water; the hands are extended and the legs partially flexed and spread so as to offer the greatest possible floating surface. In attempting to save a drowning person, the swimmer should approach him from behind, and keep him from sinking by raising him by the hair, or by placing the hands under his armpits, taking care that the struggler does not seize him, or both may be drowned. An exhausted or cramped swimmer may be supported by placing his hand on the shoulder of another swimmer. As salt water is more buoyant than fresh, it is easier to swim in it. The best time for the exercise is in the forenoon between breakfast and luncheon, when the stomach is neither full nor empty. For swimming matches the training

is like that for any other exercise, which, according to Capt. Webb, the channel champion, "simply means a healthy life."—In ancient times Leander, according to Greek tradition, swam the Hellespont from Abydos to Sestos; and on March 3, 1810, Lord Byron and Lieut. Eckenhead swam over the same course in 70 minutes, which till recently has been regarded as the greatest feat of the kind in modern times. In 1849 John Leahy, then a British soldier in quarters at Aden, and since 1868 teacher of swimming at Eton college, swam in the Red sea 2½ m. in three quarters of an hour. In August, 1868, Harry Parker swam in the Serpentine 500 yards in 7 m. 45 sec. On Aug. 5, 1872, in the lake at Hendon, near London, J. B. Johnson swam a mile in 26 minutes, doing the first half mile in 12 minutes. In 1874 Matthew Webb, then 26 years old, swam out as far as Varne buoy, 10 m. off Folkestone, and was in the water 4½ hours. The year 1875 is memorable for extraordinary swimming feats. On April 10 Paul Boyton of New Jersey attempted to cross the English channel from Dover in a swimming costume invented by Capt. C. S. Merriman of New York. He was in the water nearly three hours, propelling himself with a paddle having a blade at each end, accomplishing as the tide and waves carried him about 27 m.; and after tossing about three hours more in the surf, he was taken on board a steamer. On May 29 he successfully crossed from Cape Gris Nez to South Foreland, 3 m. from Dover, by his course about 36 m., in 23 hours. These were hardly swimming feats, but the usefulness of the costume and means of propulsion in saving life and property on the water was fully demonstrated. On July 3 Webb swam from Blackwall pier to Gravesend, 20 m., in 4 h. 42 m. 44 sec. On July 23, at Chester, Pa., in a match with Coyle, J. B. Johnson swam 10½ m. in 3 h. 10 m. On Aug. 12 Webb made his first attempt to cross the channel. He swam out from Dover 18½ m. in 6 h. 45 m., when on account of the roughness of the sea he was taken on board a lugger. On Aug. 24–25 he successfully crossed from Dover to Calais, the tide making his course a zigzag of about 50 m., in a little less than 22 h. He had no other covering than a coating of porpoise oil, and received no refreshment but hot coffee, beef tea, cod-liver oil, and an occasional sip of brandy, which he took while treading water. On Sept. 1 Agnes Beckwith, 14 years old, daughter of a teacher of swimming, swam from London bridge to Greenwich pier, about 5 m., in 1 h. 7 m. 45 sec. On Sept. 4 Emily Parker, 14 years and 6 months old, sister and pupil of Harry Parker, the champion swimmer of London, swam the same distance in 1 h. 8 m.—Illustrated treatises on swimming with instructions may be found in Walker's "British Manly Exercises" (London, 1844; latest ed., 1874), and in "Animal Locomotion, or Walking, Swimming, and Flying," by J. Bell Pettigrew (London and New York, 1875). Sergeant Leahy has published "The Art of Swimming in the Eton Style," with a preface by Mrs. Oliphant (Norwich, 1875), and Capt. Webb "The Art of Swimming," edited by A. G. Payne (London, 1875).

**SWINBURNE, Algernon Charles,** an English poet, born in London, April 5, 1837. He is a son of Admiral Charles Henry Swinburne. After studying in France, he entered Balliol college, Oxford, in 1857, but left the university without graduating. He has published "The Queen Mother" and "Rosamond," two plays (1860); "Atalanta in Calydon," a tragedy in the Greek form (1864); "Chastelard, a Tragedy" (1865); "Poems and Ballads" (1866; republished in New York under the title "Laus Veneris"), which was soon suppressed by the publisher; "Notes on Poems and Reviews" (1866), a reply to his critics; "A Song of Italy" (1867); "William Blake, a Critical Essay" (1868); "Notes on the Royal Academy Exhibition" (1868), with W. M. Rossetti; "Siena, a Poem" (1868); "Ode on the Proclamation of the French Republic" (1870); "Bothwell, a Tragedy" (1870); "Songs before Sunrise" (1871); "Essays and Studies" (1875); "George Chapman, a Critical Essay" (1875); and "Erechtheus," a play on the Greek model (1875). He has edited "Christabel, and the Lyrical and Imaginative Poems of S. T. Coleridge" (1869), and Chapman's works (1875).

**SWINE.** See Hog.

**SWING, David.** See p. 905.

**SWITZERLAND** (Lat. *Helvetia;* Ger. *Schweiz;* Fr. *La Suisse*), a federal republic of central Europe, between lat. 45° 50′ and 47° 50′ N., and lon. 5° 55′ and 10° 30′ E. It is bounded N. by Germany, E. by Austria and Liechtenstein, S. by Italy and France, and W. by France; and nearly the entire boundary line is formed by rivers (the Rhine and Doubs), lakes (of Constance and Geneva), and mountains (the Alps and Jura). In its greatest length it measures 210 m.; in its greatest breadth, 140 m. Switzerland is the most mountainous region of Europe, and, with Tyrol and Savoy, which border it on the east and southwest respectively, the most elevated. Even the most level part in the north presents mountains rising upward of 2,000 ft. It is covered throughout almost its whole extent by the Alps, of which the following groups, with their various branches, belong properly to Switzerland: 1, the Pennine Alps, separating the canton of Valais from upper Savoy on one side and Piedmont on the other; 2, the Lepontine or Helvetian Alps, including the divergent Bernese Alps, extending on both sides of the Rhône, and separating Switzerland from Lombardy; 3, the Rhætian Alps, beginning at Monte Bernardino and extending along the frontiers of Switzerland, Italy, and Tyrol. (See Alps.) The principal Alpine summits in Switzerland, such as the Monte Rosa, Matterhorn or Mont Cervin, Finsteraarhorn, and Jungfrau, ranging between 15,200 and 13,700 ft., are treated separately


SWITZERLAND
English Miles
5 10 20 30 40
84°
Longitude East 85°
47°
46°
7°
Longitude East 8°
Mühlheim
Mühlhausen
Altkirch
Huningen
BASEL
Rheinfelden
Schopfheim
Delle
Pfirt
Porrentruy
Delemont
S. Ursanne
Blamont
S. Hyppolite
Liestal
Sissach
Waldenburg
Ballsthal
Olten
Aarburg
Zofingen
Wangen
Solothurn
Soleure
Bienne or Biel
Neuveville
Chaux de Fonds
Le Locle
Morteau
Büren
Aarberg
Rapperswyl
Burgdorf
Kirchberg
Utzensdorf
Herzogenbuchsee
Langenthal
Huttwyl
NEUCHATEL
L. of Neuchâtel
Boudri
Travers
les Verrieres
Pontarlier
S. Aubin
Grandson
S. Croix
Yverdun
Estavayer
Payerne
Avenches
Morat
Murten
L. Morat
Ins
Erlach
Laupen
BERN
Köniz
Belp
Worb
Munsingen
Langnau
Fribourg
Thun
Oberhofen
Unterseen
Interlaken
Brienz
Grindelwold
Lauterbrunnen
Jungfrau
Wimmis
Frutigen
Kandersteg
Adelboden
Lenk
Saanen
Chat d'Oex
Bulle
Gruyeres
Romont
Moudon
Lucens
Echallens
Orbe
Vallorbe
La Sarraz
Cossonay
le Brassus
Bière
LAUSANNE
Lutry
Cully
Vevey
Montreux
Villeneuve
Aubonne
Rolle
Gland
Nyon
Celigny
Coppet
Versoix
Ferney
Carouge
GENEVA
S. Julien
LAKE OF GENEVA
L. Leman
Evian
Thonon
Meillerie
Douvaine
Bonneville
Cluses
Sallanches
S. Gervais
Valley of Chamouni
M. Blanc
Aigle
Bex
Monthey
S. Maurice
Martigny
Orsieres
Liddes
G. S. Bernard
Aosta
Sion or Sitten
Sierre
Leuk
Visp
Brieg
Zermatt
Matterhorn
M. Rosa
Rhone R.
Evolena
Bietschorn
Tschingelhorn
Gemmi
Diablerets
P I E D M O N T
F R A N C E
B A D E N

ashington
86°
87°
WÜRTEMBERG
BAVARIA
LAKE OF CONSTANCE
Ueberlingen
Meersburg
Friedrichshafen
Lindau
Bregenz
Dornbirn
Radolfzell
SCHAFFHAUSEN
Schaffhausen
Schleitheim
Stühlingen
Neunkirch
Thaingen
Unter L.
Stein
Constance
Waldi
Altnau
Altenswil
Weinfelden
Bürglen
Romanshorn
Arbon
Rorschach
Rheineck
Frauenfeld
THURGAU
Wangi
Bischofzell
Wil
Oberbüren
St. Gall
Flawyl
Herisau
Trogen
Altstädten
APPENZELL
Appenzell
Urnash
Lichtensteig
Dieboldsau
Hohenembs
Montlingen
Vorarlberg
Feldkirch
TYROL
Bludenz
Vaduz
R. Rhine
R. Ill
Seesaplana
Sulzfluh
St. Gallenkirch
Zurzach
Kaiserstuhl
Stadel
Bülach
Dättlikon
Winterthur
Elgg
Kyburg
Regensberg
Baden
ZÜRICH
Zürich
Höngg
Greifensee
Pfäffikon
Uster
Bauma
Pfäf L.
Erlenbach
Mannedorf
Bubikon
Rapperschwyl
Lake of Zurich
Uznach
Toggenburg
Ebnat
M. Sentis
Haag
Werdenberg
Wallenstadt
Sevelen
Flums
Wesen
Wallenstadt L.
Mühlehorn
Näfels
Glarus
GLARUS
Schilt M.
Sargans
Mayenfeld
Malans
Schiers
Zizers
Weisstannen
Vättis
Trimmis
Coire or Chur
Ems
Reichenau
Flims
Panix
Brigels
Ilanz
Kastris
Tomils
Scharans
Thusis
Sils
Tiefenkasten
Salux
Tinzen
Andeer
Thalkirch
Splugen
Splugen P.
Hinterrhein
Up. Rhine
Canicul
Molins
Bivio
Silvaplana
Sils
Silser L.
Mt. Bernina
Casaccia
Stampa
Chiavenna
M. Oro
GRISONS
Langwies
Malix
Am Plat
Glaris
Monstein
Filisur
Latsch
Bergün
Bravo
Capella
Scanfs
Bevers
Samaden
Ober Engadin
Davos
Dörfli
Klosters
Sernaus
Saas
Silvretta Gl.
Fermunt Pk.
Martinsbruck
Remus
Fetan
Unter Engadin
Schuls
Lavin
Süs
Tarasp
Zernetz
Münster
Valcava
P. Umbrail
Livigno
R. Spöl
Bormio
ALPS
Poschiavo
Brusio
Mt. Masuccio
Tirano
Edolo
Sondrio
Chiesa
Morbegno
Mezzola
R. Adda
Zug
ZUG
Zugersee
Kappel
Ägeri
Einsiedeln
Rothenthurm
Wollerau
Lachen
Bilten
Schwytz
SCHWYTZ
Iberg
Muotta
Linththal
Elm
Küssnacht
Art
Lake Lucerne
Brunnen
Sissigen
Flüelen
Altorf
Seedorf
Erstfeld
Scherhorn
Tödi
Seelisberg
Amsteg
Wasen
Meien
Disentis
Sedrun
Platta
Vrin
Surrhein
S. Martin
Andermatt
Realp
Furca
S. Gotthard
S. Maria
Airolo
Quinto
Bedretto
R. Tessin or Ticino
Faido
Olivone
Dongio
Giornico
Biasca
Osogna
Bernardino
Mesocco
Rossa
Busno
R. Moesa
Roveredo
Bellinzona
Gordune
Gerra
Sonogno
Brione
Maggia
Fusio
Mogno
Bignasco
Cevio
Locarno
Ascona
Brissago
Magadino
M. Cenere
Sigirino
Bogno
Lugano
Agno
Porlezza
P. Tresa
Mendrisio
Balerna
Chiasso
Stabbio
Varese L.
Como
Lake Maggiore
Lake of Como
Lake of Lecco
Lecco
Bellano
Bellaggio
Dongo
Gravedona
Canobbio
Pino
Luino
Intra
Angera
Sesto Calende
L. Orta
Orta
Ornavasso
Crodo
R. Tosa
S. Maria
Piazza
Clusone
Breno
L. d'Iseo
Bergamo
LOMBARDY
TICINO
URI
UNTERWALDEN
Engelberg
Titlis
Gadmen
Susten
Guttannen
Melchthal
Sarnen
Kerns
Engelberg
Ob Rüti
Baldegg
Sempach
Lake
Lucerne
46°
47°
reenwich
9°
10°


SWITZERLAND
English Miles
5 10 20 30 40
Longitude East 85° from Washington
84° 86° 87°
Longitude East 8° from Greenwich
7° 9° 10°
47° 46°
BADEN
WÜRTEMBERG
BAVARIA
TYROL
Vorarlberg
FRANCE
SAVOY
PIEDMONT
LOMBARDY
LAKE OF CONSTANCE
LAKE OF GENEVA
L. Leman
L. of Neuchatel
Lake of Lucerne
SCHAFFHAUSEN
BASEL
ZÜRICH
THURGAU
APPENZELL
ST. GALL
AARGAU
SOLEURE
LUCERNE
BERN
NEUCHATEL
FRIBOURG
VAUD
GENEVA
VALAIS
TICINO
GRISONS
URI
SCHWYTZ
UNTERWALDEN
GLARUS
ZUG
ALPS
LAUSANNE
Bregenz
Lindau
Friedrichshafen
Meersburg
Ueberlingen
Constance
Mühlhausen
Mühlheim
Schopfheim
Rheinfelden
Aarau
Solothurn
Soleure
Bienne or Biel
Thun
Interlaken
Jungfrau
Schreckhorn
Finsteraarhorn
Wetterhorn
Lauterbrunnen
Grindelwald
S. Gotthard
Altorf
Schwytz
Glarus
Coire or Chur
Splugen
Mt. Bernina
Bellinzona
Locarno
Lugano
Como
Chiavenna
Sondrio
Matterhorn
Mt. Rosa
Zermatt
Brieg
Sion
Martigny
Aosta
M. Blanc
Domo d'Ossola
Vevey
Montreux
Rolle
Nyon
Carouge
S. Julien
Bonneville
Pontarlier
Yverdun
Grandson
Chaux de Fonds
Le Locle
Morteau
Porrentruy
Delemont
Delle
Belfort
Dornbirn
Feldkirch
Bludenz
Vaduz
Bormio
Tirano
Edolo
Breno
Lecco
Bergamo
L. d'Iseo
Varese L.
Sesto Calende
Arona
Varallo
Orta
Chatillon
Sallanches
S. Gervais
Cluses
Thonon
Evian
Douvaine
Bregenz
R. Rhine
R. Rhone
R. Adda
R. Inn

under their respective names. To the west of the Alps, between France and Switzerland, extends the Jura range of mountains. (See Jura.) There are many points of view whence the semicircular array of peaks, presented at once to the eye, extends for more than 120 m., and comprises between 200 and 300 distinct summits, capped with snow or bristling with bare rocks. Of the heights commanding such panoramas, the Rigi is probably the finest and is one of the most accessible. (See Rigi.) The Faulhorn, in the Bernese Oberland, affords a fine view of the High Alps rising close at hand. For a near view of Alpine scenery, among the spots which afford a concentration of the grandest objects are the valleys of the Bernese Oberland, and those which descend from Monte Rosa in Valais. In these districts the glaciers are seen to great advantage. A description of the Swiss Alpine passes, the carriage roads, including those recently opened, and the railway over the St. Gothard pass now (1876) in course of construction, is given in Alps. Of the Alpine defiles, the ravine of the Via Mala, on the upper Rhine in Grisons, is one of the most sublime scenes. The gorge of the Schöllenen on the St. Gothard, that of Gondo on the Simplon, and the glen in whose depths the baths of Pfäfers are sunk, also deserve mention. The glaciers of Switzerland are the reservoirs which feed some of the largest rivers of western Europe, including the upper Rhine, which flows within and along the boundary line of Switzerland, and then enters Germany, and the Rhône, which rises among the glaciers of the St. Gothard range near the Furca, receives the Visp, Borgne, and Dranse, and on quitting the canton of Geneva becomes a French river. The next largest river in Switzerland is the Aar, which rises in the Bernese mountains, receives the Saane, Reuss, and other affluents, and carries the waters of 14 cantons to the Rhine. The Ticino flows through the canton of that name, and passes through Lago Maggiore into Italy; and the Inn waters a part of the canton of Grisons. There are numerous waterfalls, among which are the fall of the Aar, at Handeck, in the canton of Bern; the Staubbach or Dust fall, in the Bernese Oberland; the Giesbach, on the lake of Brienz; the fall of the Sallenche, known as the Pissevache, near Martigny, Valais; Reichenbach falls, near Meiringen, Bern; the fall of Pianazzo, on the Splügen, Grisons; the Tourtemagne fall, near the Simplon road, in Valais; and the falls of the Rhine, near Schaffhausen. There are several lakes, and the more important, Bienne, Constance, Geneva, Lago Maggiore, Lucerne, and Lugano, are described in separate articles.—The more marked geological features of Switzerland are noticed in the articles Alps and Jura; and the glacial phenomena which have been most carefully studied, and which throw so much light upon the dynamics of geology, are specially treated in the article Glacier. No country possesses greater interest for geologists than Switzerland, whose formations are exhibited upon the grandest scale, and reveal in the most striking manner the metamorphism to which rocks are subject, converting strata of comparatively recent formation into schistose and crystalline rocks; but its mineral resources, including iron, lead, and copper, are of no great importance. Anthracite of inferior quality is found in several places. The salt mines near Basel and those at Bex (Vaud) are the most important. Gypsum is found with the salt, and slate is extensively quarried. There is a large number of mineral springs, many of which are famous as watering places. The most celebrated are Leuk (Valais), St. Moritz in the valley of Engadine (Grisons), Pfäfers (St. Gall), and Baden and Schinznach (Aargau).—The climate is more severe than might be expected from the geographical position of Switzerland. On the highest summits snow and ice are perpetual. On the lower mountains and the table land snow falls in greater abundance than in other countries of the same latitude in Europe. In Valais the fig and grape ripen at the foot of ice-clad mountains, while near their summits the rhododendron and the lichen grow at the limit of the snow line. Ticino has the climate of Italy, yet the weather is more changeable. Switzerland on the whole is very healthful, with the exception of a few places in swampy or very narrow and deep valleys. In the middle ages the country of the Jura suffered much from earthquakes, which have entirely ceased for several centuries; but floods, avalanches, and snow storms still threaten the inhabitants with frequent dangers. About two thirds of the surface consists of lakes and other waters, glaciers, naked rocks, and other uninhabitable heights. Some districts are very fruitful, yet the grain raised is not sufficient for the supply of the population. The vine is cultivated on the slopes of the Jura and in the valleys of the Rhine, Rhône, Reuss, Limmat, and Thur, and in some places ripens at 2,000 ft. above the sea. The annual production is valued at about $6,000,000. Flax and hemp are extensively grown. Irrigation is judiciously managed, and in general agriculture is making progress. The forests cover about 17 per cent. of the soil, and although their cultivation is imperfect, the production of timber exceeds the home consumption. Fishing still yields considerable produce, but hunting is not practised to the same extent as formerly, and in some of the cantons it is forbidden by law. Chamois are still found in the Alps; other animals are bears, wolves, wild boars, and roebucks; foxes and hares are numerous, and otters are found in some of the lakes. Switzerland is celebrated for its rich and excellent pastures; the finest breeds of cattle are those of the Simmenthal and Saanen (Bern), Gruyère (Fribourg), Zug, and Schwytz. In 1866 there were 993,000 horned cattle (about one fourth milch cows), 100,000 horses, 447,000 sheep, 375,000 goats, and 304,000 swine.

The sheep and swine do not supply the home demand. The best cheese is made in Gruyère and in Urseren (Uri), and in the valleys of the Emmen, Saane, and Simmen.—While Switzerland is mainly agricultural, certain classes of manufactures are prosperous and important. The chief seats of the cotton manufacture are Aargau, Appenzell, St. Gall, Zug, and Zürich. The number of mills in 1870 was 168, and of spindles 2,059,350, employing 20,000 operatives, besides 38,000 hand-loom weavers. This estimate includes 6,000 workers in Appenzell and St. Gall employed in the manufacture of embroidery alone, to the annual value of $2,000,000. Basel employs 6,000 persons in the manufacture of silk ribbons, to the annual value of $7,000,000, and 12,000 operatives in Zürich make silk stuffs of the annual value of $8,000,000. In Bern, Geneva, Neufchâtel, Solothurn, and Vaud 36,000 persons produce annually 1,600,000 watches, valued at $17,600,000. The movements of many of these are exported to be cased in other countries. Wood carving is carried on in most of the cantons. Vaud produces annually 80,000 musical boxes. The exports of Switzerland to the United States for the year ending Sept. 30, 1874, amounted to $12,270,368, including watches to the value of $2,423,993. The value of the foreign trade in 1868 was set down at $93,600,000 of exports and $84,000,000 of imports. The principal articles of import are grain, flour, wine and cider, iron, raw cotton, coal, and petroleum. The aggregate length of railway lines, Jan. 1, 1874, was 916 m. They are all private roads, with the exception of the Bern railway, which belongs to the state. The aggregate length of telegraph in 1873 was 6,322 m., with 715 stations.—Switzerland consists of 22 cantons, or, as three cantons, Unterwalden, Appenzell, and Basel, are divided into two independent half cantons each, of 25 states, the area and population of which are as follows:

| CANTONS. | Area in sq. m. | Population in 1870. | Catholics. | Protestants. |
|---|---|---|---|---|
| Aargau | 542 | 198,873 | 89,180 | 107,703 |
| Appenzell Outer Rhodes | 100 | 48,726 | 2,358 | 46,175 |
| Appenzell Inner Rhodes | 63 | 11,913 | 11,720 | 188 |
| Basel City | 14 | 47,760 | 12,301 | 34,455 |
| Basel Country | 162 | 54,127 | 10,245 | 43,523 |
| Bern | 2,660 | 506,561 | 66,015 | 436,304 |
| Fribourg | 643 | 110,832 | 93,951 | 16,819 |
| Geneva | 109 | 93,239 | 47,868 | 43,639 |
| Glarus | 267 | 35,150 | 6,888 | 28,238 |
| Grisons | 2,774 | 91,782 | 39,843 | 51,887 |
| Lucerne | 579 | 132,338 | 128,338 | 3,823 |
| Neufchâtel | 312 | 97,284 | 11,590 | 84,334 |
| St. Gall | 780 | 191,015 | 116,060 | 74,573 |
| Schaffhausen | 116 | 37,721 | 3,051 | 34,466 |
| Schwytz | 359 | 47,705 | 47,047 | 647 |
| Solothurn | 303 | 74,713 | 62,078 | 12,448 |
| Thurgau | 382 | 93,300 | 23,454 | 69,231 |
| Ticino | 1,095 | 119,619 | 119,350 | 194 |
| Unterwalden, Upper | 183 | 14,415 | 14,055 | 358 |
| Unterwalden, Lower | 112 | 11,701 | 11,632 | 66 |
| Uri | 415 | 16,107 | 16,018 | 80 |
| Valais | 2,026 | 96,887 | 95,963 | 900 |
| Vaud | 1,244 | 231,700 | 17,592 | 211,686 |
| Zug | 92 | 20,993 | 20,082 | 878 |
| Zürich | 665 | 284,786 | 17,942 | 263,730 |
| Total | 15,988 | 2,669,247 | 1,084,525 | 1,566,345 |

Fourteen of these divisions have capitals of the same names; those of the remaining eleven are as follows: Aargau, Aarau; Appenzell Outer Rhodes, Trogen and Herisau, alternating; Basel Country, Liestal; Grisons, Coire; Thurgau, Frauenfeld; Ticino, Lugano, Locarno, and Bellinzona, alternating; Upper Unterwalden, Sarnen; Lower Unterwalden, Stanz; Uri, Altorf; Valais, Sion; Vaud, Lausanne. Of the entire population 94·3 per cent. were natives, and 5·7 foreigners, including 63,000 Germans, 62,000 French, and 18,000 Italians. The number of communes in 1870 was 3,052, of which 5 had a population of more than 20,000, 7 from 10,000 to 20,000, 31 from 5,000 to 10,000, and 251 more than 2,000. The number of houses was 387,148, and of families 557,018. The excess of females over males was about 59,500. The number of births in 1871 was 81,629, and of deaths 77,998. The population has increased since 1816 about 50 per cent., more slowly than that of the United States and Great Britain, but in a much larger ratio than that of France. Geneva, Basel, and Neufchâtel have increased nearly 100 per cent.; Lucerne and Bern more than 50; Zürich nearly 50. Since 1860 every canton except Appenzell Inner Rhodes shows an increase of population. Of the entire population in 1870, 1,095,447 were wholly or partly supported by agriculture; the manufactories employed 216,468, and the handicrafts 241,425. The difference of language points to the difference of origin of the inhabitants of the several cantons. The N., N. E., and central cantons speak a German dialect; French prevails in Vaud, Geneva, and Neufchâtel, and in parts of Valais, Fribourg, and Bern; Italian in Ticino and in a part of Grisons; and Romansh, a corrupted dialect of the Latin, in a part of Grisons. The population speaking these four languages is classified by the census of 1870 as follows: German is spoken in 384,538 families, French in 133,575, Italian in 30,079, Romansh in 8,778, and other languages in 48. A majority of the inhabitants are Protestants, but the Roman Catholics are most numerous in 11 cantons and one half canton, viz.: Appenzell Inner Rhodes, Fribourg, Geneva, Lucerne, St. Gall, Schwytz, Solothurn, Ticino, Unterwalden, Uri, Valais, and Zug. They have five bishops, viz.: of Basel, Coire, Fribourg, St. Gall, and Sion. There are also priests with the functions of prefects apostolic to minister to scattered Catholics. In 1872 the pope erected Geneva into a new diocese, but the cantonal government denounced the measure as contrary to law. In 1873 the pope made it an independent vicariate apostolic, and the bishop of Fribourg resumed the former additional title of Lausanne, but the federal council refused to recognize it. In 1873–'4 several parish churches, especially in the cantons of Aargau, Bern, Geneva, and Solothurn, passed into the possession of the Old Catholics. The Jesuits and Redemptorists are excluded by the federal con-

stitution from Switzerland, and the number of the convents of other religious orders has been somewhat reduced during the present century; in 1874 it amounted to 88. The constitution of 1874 forbids the founding of new convents. The Protestants belong mostly to the Reformed church. Since 1857 deputies of the Reformed cantonal churches meet annually in a Helvetic conference. Faculties of Protestant theology are connected with the universities of Bern, Zürich, and Basel, and there are also several theological schools in French Switzerland; in Bern a faculty of Old Catholic theology was established in 1874. Basel is the seat of the greatest missionary and Bible society of continental Europe, while the religious societies of French Switzerland have their centre in Geneva. Free churches (Presbyterian or Independent) have been formed during the present century by secession from the state churches, and are especially numerous in the cantons of Geneva, Neufchâtel, and Vaud, in each of which they have a theological school. The Methodists and Baptists have congregations in several cantons, and the former also a book concern at Zürich. In 1870 the number of Jews amounted to 6,996.—Switzerland has three full universities, at Basel, Bern, and Zürich. The former was founded in 1460, the two latter since 1832. All are organized after the model of the German universities, governed by a rector and a senate, and divided into faculties, of which Basel has four, Zürich five, and Bern six. There are also four academies, at Geneva, Lausanne, and Neufchâtel, each with three faculties, and Fribourg with two faculties; three lyceums, at Lugano, Einsiedeln (Schwytz), and Sion; and nine theological schools. The academy at Geneva (called also university), founded in 1368, the scene of Calvin's and Beza's teaching, has hitherto lacked a medical faculty. This will soon be added, completing the university. All the academies except that of Fribourg are Protestant, all the lyceums Catholic. The number of gymnasia and cantonal schools is 47. The federal constitution of 1848 provided for the establishment of a federal university (the three above mentioned being cantonal institutions); but the conflicting claims of several cantons as to its location, and of the Reformed and Roman Catholic churches as to its organization, have prevented the execution of the plan. A federal polytechnic school was founded in 1854 at Zürich, and has attained a high degree of prosperity and celebrity. In 1874 it had 73 professors and 676 students, and 275 pupils who study one or more branches at their option. The number of public schools amounts to about 7,000, educating upward of 400,000 pupils. There is a federal military academy at Thun (Bern). The expenses of public instruction are partly paid by the communities, partly by special school funds, and partly by appropriations of the cantonal governments; and the constitution requires that all children must attend school from their 7th to their 14th year. Many private educational institutions have gained a world-wide celebrity since the days of Pestalozzi and Fellenberg, who conducted establishments of this kind at Yverdun (Vaud) and Hofwyl (Bern). Considerable attention is given to musical instruction, and in 1874 the federal singing societies numbered 8,552 members. The Alpine valleys are remarkable for their peculiar local melodies. (See Ranz des Vaches.) The number of periodicals published in Switzerland in 1872 was 412, of which 266 were in German, 118 in French, 16 in Italian, 5 in Romansh, 1 in English, and 6 in German and French. The aggregate number of copies issued was 90,800,000.—The first federal constitution of Switzerland, which superseded the federal contract of Aug. 7, 1815, and changed the federal union of states into a federal republic, was promulgated Sept. 12, 1848. A revised constitution was submitted to the people on April 19, 1874, and, having received the constitutional majority, came into force on May 29. It provides that all the rights of sovereignty which are not expressly transferred to the confederacy are exercised by the 25 cantons and half cantons. Among the prerogatives of the federal government are the rights of declaring war, of concluding peace or treaties, and of sending diplomatic representatives. The formation of separate alliances between the cantons, without special permission, is prohibited. The constitution of every canton is guaranteed, if it is republican in form, if it has been adopted by the people, and if it can be revised on the demand of a majority of the citizens. All Swiss are equal before the law, and the former relation of subjects as well as all privileges of place or birth are abolished. There shall be complete and absolute liberty of conscience and of creed. No one can incur any penalties whatsoever on account of his religious opinions. The father or guardian has the right to dispose of the religious education of the children up to the age of 16 years. No one is bound to contribute to the expenses of a church to which he does not belong. The free exercise of worship is guaranteed. Civil marriage is compulsory, and a subsequent religious ceremony is optional. The cantons have the right to maintain peace and order between different religious communities, and to prevent encroachments of ecclesiastical authorities upon the rights of citizens. No new bishoprics can be created without the approbation of the federal government. Liberty of the press, of petition, and of association is guaranteed; but the Jesuits and all religious orders and associations which are affiliated to them are prohibited; all functions, clerical and scholastic, are forbidden to Jesuits, and this interdiction can be extended to any other religious order whose action may be deemed dangerous to the state. The confederacy has the right of sending away dangerous foreign-

ers. The legislative power is vested in the federal assembly, which consists of a national council and a council of states (Ger. *Ständerath;* Fr. *conseil des états*). The national council consists of deputies of the people, in the ratio of about one for every 20,000 persons, so that every canton and every independent half canton has the right of electing at least one councillor. On the basis of the census of 1870 the council consists of 135 members. The national council is elected for the term of three years, and every citizen who is 20 years of age has the right of voting, and any voter, not a clergyman, is eligible. Naturalized citizens may be elected after being citizens for five years. The council of states has 44 members, two for every canton and one for every half canton. The members of the national council are paid out of the federal treasury, those of the council of states by the cantons. The executive power is exercised by a federal council, consisting of seven members, who are chosen for a term of three years by the federal assembly (the national council and the council of states in joint session). They divide among themselves the seven departments of foreign affairs, of the post and telegraphs, of justice and police, of finance, of war, of the interior, and of commerce and duties, each member taking one department and being at the same time the substitute in a second department. The president and vice president of the federal council, who are also president and vice president of the confederation, are chosen for one year only, and by the council itself from among its own members, and are not reëligible till after the expiration of another year. The federal court, which is also chosen by the federal assembly for a term of six years, consists of nine members and nine substitutes, and has its seat at Lausanne. The constitution may at any time undergo a revision in the regular way of legislation; if the two councils disagree, or if 50,000 citizens demand it, the question of a revision has to be submitted to a direct vote of the people. The revised constitution, in order to become effective, must be adopted by a majority of all citizens of Switzerland as well as by a majority of the cantons. The cantonal constitutions may be divided into two classes: 1. Pure democracies, in which the rights of sovereignty are exercised by a general assembly of all citizens, which meets once a year, mostly in April or May, votes upon laws, fixes the taxes, and elects the cantonal officers. The executive is called *Landrath*, and consists of the cantonal officers and the councillors elected by the several political communities. This is the constitution of Uri, Appenzell, Unterwalden, and Glarus. 2. Representative democracies, in which the people elect a legislative assembly, called the grand council, which chooses from its own number the executive, called little council. In many cantons the people have the right of vetoing every bill passed by the grand council. In most of the cantons the members of the grand council receive no pay. Instead of printed law books, some of the smaller cantons used until recently written traditions; but now nearly every canton has its printed code of laws. Many old Germanic elements are to be found in Swiss law; the Roman law has had a predominating influence only in a few border cantons. The institution of the jury, which was first tried in Geneva, has since been introduced into several other cantons. The federal capital is Bern.—The finances of Switzerland are in a very favorable condition. In 1873 the entire revenue, the greater part of it derived from duties and the postal system, was $7,152,704, and the expenditures were $7,154,712. Since 1848 duties are levied only on the frontiers of the republic, and not, as before, on the limits of each canton. A portion of the customs dues, as well as a great portion of the postal revenue, are paid over to the cantonal governments, in compensation for the loss of such former sources of income. In extraordinary cases, the federal government may levy a rate upon the various cantons after a scale settled for 20 years. The public debt at the close of 1873 amounted to $5,650,000, and the federal property to $5,691,000. The aggregate income of all the cantons in 1868 amounted to $8,320,000, the aggregate expenditures to $8,630,000. Schaffhausen and Appenzell Inner Rhodes had no public debt; many other cantons formerly without debt have of late contracted one for the purpose of building railways. In the majority of cantons the public property exceeds the debt. In 1868 the aggregate property belonging to the cantonal governments amounted to $54,770,000, and the aggregate debts to only $33,660,000.—The military establishment of Switzerland is based upon purely democratic principles. The fundamental laws of the republic forbid the maintenance of a standing army within the limits of the confederation. Every able-bodied citizen is actually a defender of the republic. The federal army consists of citizens from 20 to 44 years of age, and is divided into three classes according to age. The first class, comprising men from 20 to 34 years of age, constitutes the active field army; the second class, 34 to 40 years, the reserve army; and the third class, 40 to 44 years, the sedentary militia. The constitution of 1874 considerably extends the federal control in military matters. Both the army and the war material are at the disposal of the confederation, which in cases of emergency has the exclusive right to dispose of the men who do not belong to the federal army. All the laws relative to the army are enacted by the confederation, which also provides for the education of the troops. The Thun military academy furnishes the army with the highest class of officers and with instructors for the lower grades. There are special schools for different

branches of the service, especially for the artillery and riflemen. All the different classes are required to devote a certain number of days in each year to battalion and brigade drills and field manœuvres. The Swiss are accurate marksmen with the rifle, and meet constantly to practise and engage in trials of skill. There are clubs and societies in almost every valley and parish, and frequent matches; besides which a federal rifle match is held every year. The number of riflemen in the army list of 1874 was 13,918. Annual contests in wrestling also are held in many parts of Switzerland. In September, 1874, the field army numbered 84,369 men, the reserve army 50,069, and the militia 65,981; making, with administrative troops and the sanitary corps, a total of 201,257.—The first inhabitants of Switzerland are supposed to have been of Celtic origin, and to have immigrated from the northeast. Their collective name was Helvetians. (See Helvetii.) The high valleys near the sources of the Rhine, in the present canton of Grisons, were occupied by a tribe akin to the Tyrrhenians or Etruscans, called the Rhætians. In 113 B. C. two tribes of Helvetians, the Tigurini and Tugeni (from which are derived the names of Zürich and Zug), joined the Cimbri and Teutons in their inroads into Italy. In this war the Helvetian Divico, in 107, completely routed the Romans under their consul L. Cassius Longinus. After the defeat of the Cimbri in 101, the Helvetians returned unmolested to their mountains, followed, it is believed, by the scattered remnants of the Cimbri, to whom the foundation of the town of Schwytz is ascribed. In the time of Cæsar an entire tribe of the Helvetians, instigated by their leader Orgetorix, determined to conquer seats in Gaul, destroyed their towns and villages, and under the command of Divico crossed the Saône; but they were conquered by Cæsar at Bibracte (Autun), and driven back to their country. Soon afterward the Helvetian tribes were gradually subdued by the Romans, and even the Rhætians, who were the last to maintain their freedom, were compelled at length to yield. For several centuries Switzerland remained a province of the Romans, who introduced their manners, laws, and civilization, and founded several towns, as Augusta Rauracorum (Augst, near Basel), Curia Rhætorum (Coire), Vindonissa (Windisch, in Aargau), Aventicum (Avenches, in Vaud), and Eburodunum (Yverdun). In the 2d, 3d, and 4th centuries the country was often harassed by the invasion of German tribes, especially the Alemanni; the Celtic and Roman elements of the population mostly perished, the towns were sacked, and the country laid waste. In the 5th century the Burgundians, Alemanni, and Goths divided the country among themselves; but their dominion was short, and in the 6th century they were all brought into subjection by the Franks. Christianity, which had already begun to take root in Burgundian Switzerland, became under the rule of the Franks the religion of the entire country. Many bishoprics and convents were founded, and the bishops and many abbots obtained great political influence. Though wholly incorporated with the empire of the Franks, the country was in point of administration divided into two parts: the one, extending from the lake of Constance and the Rhine to the Aar and St. Gothard, was called Rhætia and Thurigau; and the other, comprising the present cantons of Geneva, Valais, Neufchâtel, Bern, Fribourg, Solothurn, &c., was called Little Burgundia. Under the weak reign of Charles the Fat (died 888), Switzerland, like many other parts of the empire, was lost to the Franks. The N. part came into the possession of the duke of Alemannia (Swabia), and thus became part of the German empire, while the S. part belonged to Burgundy. During the invasion of Germany by the Hungarians in the 10th century, many towns, as St. Gall, Basel, Zürich, and Lucerne, were fortified, and rose in importance. During the reign of the emperors of the house of Saxony the country was mostly held as fiefs by the vassals of the empire, in particular by the bishops and abbots, the counts of Kyburg (Zürich), Hapsburg and Lenzburg (Aargau), and Rapperswyl and Toggenburg (St. Gall); later also by the count of Savoy and the duke of Zähringen. Many of these noble families became extinct during the crusades; and the power and prosperity of the towns rose still higher, Bern and Fribourg even becoming free cities of the German empire. Zürich, Bern, and Basel formed an alliance, and tried to make themselves independent. Yet the independence of Switzerland did not proceed from them, but from the three ancient cantons of Schwytz, Uri, and Unterwalden, the inhabitants of which are believed to have descended from immigrants from Sweden, and which had never been conquered. They were only under the protection of the German emperor, near whom their rights were guarded by a *vogt*, first a count of Lenzburg, and afterward a count of Hapsburg. The elevation of Rudolph of Hapsburg to the imperial throne of Germany in 1273, and his conquest of Austria and other possessions of Ottocar of Bohemia, greatly increased the influence of the house of Hapsburg in Switzerland. Albert, the son of Rudolph, sought to incorporate the Swiss with Austria. Bern and Zürich at once resisted successfully; but in Schwytz, Uri, and Unterwalden he succeeded for a time. The convention entered into by 33 distinguished men of the three cantons on the Grütli or Rütli, a meadow on their common frontier, during the night of Nov. 7–8, 1307, led, on Jan. 1, 1308, to the expulsion of the Austrian officers and the destruction of their castles. The legend of Tell belongs to this period. The relation of the three cantons to the German empire remained at

first unchanged; but the war of Austria for reëstablishing its rule in the emancipated cantons, which lasted with many interruptions for about 200 years, ended with severing also the ties which bound Switzerland to Germany. The Hapsburgs also lost their possessions lying between the Alps and the Rhine, and their old family castles of Hapsburg and Kyburg. The league of the three old cantons, which had first been formed in 1291 and renewed in 1308, was again established as a perpetual confederacy in 1315, after the great victory over the Austrians at Morgarten on the confines of Schwytz and Zug. In 1332 Lucerne joined the confederacy, which received the name of the Four Forest Cantons (*Vierwaldstätte*). Zürich came in in 1351, Glarus and Zug in 1352, and Bern in 1353, when the eight united cantons erected the "perpetual league of the eight old places of the confederacy," so called because no new members were added to the confederacy till 1481, and these eight enjoyed many privileges till 1798. Other victories over Austria were gained at Sempach (Lucerne), July 9, 1386, and at Näfels (Glarus), April 9, 1388; after which the Swiss became aggressive, and at length, notwithstanding their defeats at Arbedo (Ticino) in 1422 and at St. Jacob (Basel) in 1444, annexed a considerable portion of Austrian territory. These protracted conflicts awakened such a fondness for warfare that many Swiss soldiers entered foreign armies, where until a very recent period they earned the questionable reputation of being the most loyal defenders of the cause which they espoused, even if it were that of despotism. Foreign enlistment without permission was forbidden by the federal government in 1860. There were occasional internal dissensions, and Zürich from 1440 to 1450 seceded from the confederacy. As at this time Schwytz had a predominant influence in the councils of the confederacy, its cantonal colors (white and red) were adopted as the confederate ensign, and the party name Swiss (Schwytz) became the designation of the entire people. In 1475 the cantons joined France, Austria, and some of the Alsatian free towns in the league against Burgundy. The Swiss gained a great victory over Charles, duke of Burgundy, at Granson, in March, 1476; the confederates annihilated his army at Morat in June; and the war terminated with the defeat and death of the duke at Nancy in January, 1477. (See Charles the Bold.) The admission of Solothurn and Fribourg into the confederacy in 1481 threatened a civil war, which was averted by the exhortations of the hermit Nicholas von der Flue. Other internal dissensions were terminated by a war against the German emperor (1498), which was concluded by the peace of Basel in 1499, and Basel and Schaffhausen, for faithful assistance, were admitted as members of the confederacy, to which Appenzell was added in 1513. The number of cantons thus rose to 13, and remained so till 1798. The Swiss conquered Lombardy for Duke Maximilian Sforza in 1512, and routed the French at Novara in 1513, but in 1515 lost the great battle at Marignano. They found France willing to conclude with them an advantageous peace in 1516, which was kept till 1798. The reformation of the 16th century led to open war between the Reformed and Catholic cantons, but soon after the battle at Cappel (Zürich) in 1531 peace was concluded, and every canton left at liberty to introduce or to oppose the reformation. (See Reformation, vol. xiv., pp. 246-'7.) Geneva freed itself, with the aid of Bern, from Savoy, and in 1536 became a Protestant republic, but without being admitted into the confederacy. Vaud was conquered by Bern from Savoy in 1536 and reformed; but on the other hand, the Catholic cantons of Lucerne, Uri, Schwytz, Unterwalden, Solothurn, and Fribourg formed in 1586, by the advice of Archbishop Charles Borromeo of Milan, the "golden league" for the common defence of the Catholic religion. The religious split long continued a prolific source of dissension between the cantons. In 1597 the canton of Appenzell, in order to prevent a religious war, was separated into two independent half cantons, the Catholic part being called Inner Rhodes, and the Reformed Outer Rhodes. In 1602 the Reformed were expelled from Valais, and in 1620 Protestantism was forcibly suppressed in the Valtellina. In Grisons a bloody civil war was kindled, in which other cantons also took part, and which made the country one of the chief seats of the war between France, Spain, and Austria. As the federal courts of Germany still made claims on Switzerland as belonging to the German empire, the Swiss sent the burgomaster Weltstein of Basel as their representative to the peace congress of Münster, which at the peace of Westphalia (1648) pronounced Switzerland entirely independent of Germany. From this time until the outbreak of the French revolution in 1789, the history of Switzerland presents few events of general importance. It had no foreign war, and the occasional religious contests at home were generally of short duration. The most important of them was the second war of Toggenburg in 1712, when 150,000 Swiss were in arms against each other. Other internal commotions arose out of the oligarchic form of government which was gradually established in the cantons of Bern, Fribourg, Solothurn, and Lucerne, and out of the oppressed condition of the subjected territories whose inhabitants were excluded from all political rights. In 1798 two French armies marched, without any respectable pretext, into Swiss territory, captured on March 5 the city of Bern, plundered its armory and treasury, and on April 12 proclaimed at Aarau the one and indivisible Helvetic republic, divided into 18 cantons, with Aarau as the federal capital. By the new constitution Bern was divided into four

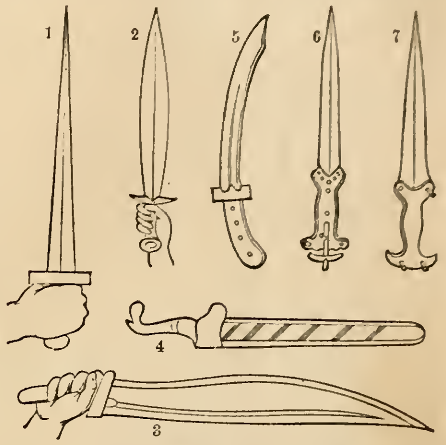
cantons, the subjected districts of Baden, Thurgau, Lugano, and Bellinzona were erected into cantons, Zug, Uri, Schwytz, and Unterwalden united into the one canton of the Forest Towns, and Appenzell, St. Gall, and the valley of the Rhine formed into the canton of Sentis. Geneva, Bienne (Bern), and several other portions of Swiss territory were incorporated with the French republic. The resistance of the old forest cantons proved useless, and the new constitution was gradually introduced. Overthrown on the entrance and advance of the allied armies under the command of Suvaroff, it was reëstablished after the victories of the French under Masséna. The withdrawal of the French troops in 1802 led at once to revolutions in almost every canton, and a general diet, consisting of an equal number of deputies from the formerly governing and the governed districts, was convoked at Schwytz; but again France interfered, 12,000 French troops subdued the old cantons, and deputies from all the cantons were ordered by Bonaparte to assemble at Paris for the purpose of reorganizing Switzerland. On Feb. 19, 1803, Bonaparte transmitted to them the act of mediation, by which the former cantonal system was restored, although the relation of subjected territories remained abolished. To the 13 old cantons 6 new ones were added, viz.: St. Gall and Grisons, which had formerly been allied with the confederacy without being members, and Aargau, Thurgau, Ticino, and Vaud, which had been subjected territories. At the head of the confederacy was again placed a diet (Ger. *Tagsatzung*), consisting of commissioners, voting according to instructions. It was to assemble in turn in the cities of Bern, Zürich, Lucerne, Basel, Fribourg, and Solothurn, and the burgomaster of the temporary capital (Ger. *Vorort*), under the name of *Landamman* of Switzerland, was to preside at the diet and to attend to all the current affairs of the year. In the democratic cantons the sovereign popular assemblies were reëstablished; in the others grand and little councils, the former being elected by a direct vote of the people, and the latter by the grand council. This new constitution was on the whole well received, and under it Switzerland for ten years enjoyed peace at home and abroad. After the battle of Leipsic the troops of the allied powers marched through Switzerland. Bern and others of the aristocratic cantons severed their connection with the Helvetic government instituted by the act of mediation, and civil broils ensued in a number of cantons. Yet the attempt to restore the former order of things had soon to be given up, and a new constitution, adopted by the federal diet on May 27, 1815, and sworn to at Zürich on Aug. 7, acknowledged all the 19 cantons constituted by the act of mediation, and added three new ones, Geneva, Valais, and the Prussian principality of Neufchâtel. This constitution was ratified by the great powers of Europe, which also declared the perpetual neutrality and inviolability of the confederation (Nov. 20). The territory of Switzerland was enlarged by portions of land ceded by France (the Dappes valley), Savoy (Carouge and several villages on the lake of Geneva and on the Rhône), and Austria (Rhäzüns, the Frickthal, Laufenburg, and Rheinfelden). The cantons of Solothurn, Grisons, Schwytz, and Appenzell Inner Rhodes adopted the constitution only with reluctance, and Nidwalden (one half of Unterwalden) had to be coerced into submission by force of arms. According to the new confederation the cantons guaranteed to each other their constitution, and united for the common defence of their independence. The diet was to assemble annually on June 1, alternately at Bern, Lucerne, and Zürich, and to it was reserved the right of declaring war, concluding peace, and forming alliances with foreign powers. The cantons retained the right of forming with foreign states special military agreements. The existence of the convents and cathedral chapters was guaranteed by a special article. The administration of federal affairs, during the time that the diet was not in session, was left to the temporary capital. In 1817 Switzerland, on the invitation of Alexander of Russia, joined the holy alliance, and from 1823 to 1828 it conceded to the urgent requests of the great powers of Europe a restriction of the liberty of the press and of the right of asylum. The aristocracy recovered in most cantons part of their former prerogatives, and several capital towns greatly enlarged their influence at the expense of the country people. The French revolution of July, 1830, led to violent political agitations in Switzerland. In several cantons the country people rose against the capital towns, and forced them to reorganize the cantonal constitutions on a more liberal and democratic basis. In the canton of Basel a permanent division into two independent half cantons, Basel City and Basel Country, was effected in 1832. In November some of the most conservative cantons, Uri, Schwytz, Unterwalden, Neufchâtel, and Basel City, formed the "league of Sarnen," and threatened to send no more commissioners to the federal diet if the commissioner from Basel Country were admitted. The federal diet interfered; the separate league was declared dissolved, and the refractory cantons had to submit to the federal authority. Altogether, liberal cantonal reforms were introduced in about two thirds of Switzerland. Encouraged by success, the progressive party conceived also the plan of revising the federal constitution, with the view of effecting a closer political union. The diet, on July 17, 1832, pronounced in favor of the revision; yet, when the amendments adopted by the diet were subjected to a direct popular vote, they were voted down by a coalition of the Catholic and radical parties. The large number of political refu-

gees, who gathered in Switzerland in consequence of the revolutionary movements of 1830, involved the country in serious difficulties with the great powers, which complained of the liberty granted to them by the federal diet. The latter endeavored to conciliate the powers by several resolutions restricting the liberty of the refugees (in 1834 and 1838), and even by the expulsion of some of the leading men among them (1836); yet the diplomatic collisions continued. The demand of the French government in 1838 for the expulsion of Louis Napoleon, who had been since 1832 a citizen of the canton of Thurgau, was declined by Switzerland, and almost led to a war, which was only avoided by his voluntary departure. An occasion for new religious contests was given by the conference at Baden in 1834, at which delegates of Bern, Basel Country, Aargau, Thurgau, Lucerne, Solothurn, and St. Gall undertook to regulate the relations of the Roman Catholic church in a manner which was rejected by the pope and the bishop of Basel as contrary to the rights and the spirit of the church. The articles of the conference provoked several insurrections, especially in the canton of Aargau, the government of which, to punish the revolted Catholic districts, decreed in 1841 the abolition of all the convents. Against this measure most of the Catholic cantons and the ambassador of Austria protested, as a direct violation of that article of the constitution of 1815 which guaranteed the continuance of convents and chapters. Upon the representations of the federal diet Aargau restored four female convents, a concession which did not satisfy Austria and the Catholic cantons; but the federal diet by 12½ votes dismissed the subject from its docket (Aug. 31, 1843). A cause of still greater trouble was a motion, made by Aargau at the diet of 1844, for the expulsion of the Jesuits from Switzerland. It was laid on the table by the diet; but when the Catholic *Vorort* Lucerne resolved (Oct. 24, 1844) to call the Jesuits to a cantonal institution, a great excitement spread throughout Switzerland. Two volunteer expeditions (December, 1844, and March, 1845) were undertaken for the purpose of overthrowing the government of Lucerne, but both were unsuccessful. On the other hand, the governments of Vaud, Bern, and Zürich, which had voted against the expulsion, had to give way to others which were in favor of the project. As thus the danger threatening the existence of the schools of the Jesuits increased, the cantons which either had called Jesuits to cantonal institutions, or which patronized them (viz., Lucerne, Uri, Schwytz, Unterwalden, Zug, Fribourg, and Valais), strengthened a separate alliance (*Sonderbund*) which had already been formed in 1843, and appointed a council of war for the emergency of a civil contest. A motion of Zürich at the diet of 1845 to declare the Sonderbund dissolved received only 10½ votes, but a change of government of Geneva and St. Gall secured for the motion a majority of 12½ votes on July 20, 1847. One Protestant canton (Neufchâtel), one Protestant half canton (Basel City), and one Catholic half canton (Appenzell Inner Rhodes) voted with the cantons of the Sonderbund. In September another resolution declared the expulsion of the Jesuits from all Switzerland. The diet collected an army of nearly 100,000 men under the command of Gen. Dufour, and on Nov. 4 resolved to execute the decree of July 20 by force of arms. The Sonderbund had raised a force of 36,000, which was to be supported by a *Landsturm* of 47,000 men. The isolated Fribourg was first attacked, and surrendered after an insignificant skirmish. On Nov. 23 the army of the Sonderbund was routed at Gislikon, near the frontier of the canton of Lucerne, the council of war, the government of Lucerne, and the Jesuits fled, and all the seven cantons submitted. In this war Lucerne was the head and centre of the seven Catholic cantons. Austria, France, and Prussia had openly declared during the war their sympathy with the Sonderbund, and in 1848 issued a joint note to Switzerland, demanding that the cantons of the Sonderbund be evacuated, and no change be made in the constitution of 1815, except by the consent of all the cantons. But the revolutions of 1848 drew off the attention of the great powers from Switzerland, and gave the latter an opportunity to hasten a thorough reformation of the federal constitution. The committee of revision began its labors on Feb. 17, 1848, and on June 27 the draft of the constitution was submitted to a direct vote of the people. A majority of the cantons and a large majority of the total population voting in favor of it, it was promulgated Sept. 12. In the same year the canton of Neufchâtel declared itself independent of Prussia, which entered against this act an inefficient protest. On Sept. 2, 1855, the royalists of Neufchâtel made an attempt to overthrow the government of the canton and to reëstablish the sovereignty of the king of Prussia. The movement was at once suppressed (Sept. 3), but led to serious complications with Prussia, which demanded the unconditional pardon of the captured royalists. The demand was supported more or less by all the great powers of Europe; and when the federal council refused to accede to it, Prussia broke off diplomatic relations, and made some warlike demonstrations. When, however, France and England promised their intercession with Prussia in behalf of a recognition of the independence of Neufchâtel, in case Switzerland would release the royalist prisoners, their advice was followed by the federal council. Prussia in 1857, at a conference of the great powers in Paris, resigned for ever its claims to Neufchâtel. In 1860 Switzerland protested against the annexation of Savoy to France, as a violation of the treaties of 1564 and 1816, by which the neutrality

of the districts of Chablais and Faucigny had been guaranteed. It demanded from France the cession of these two districts, but as it received little aid from the great powers, its representations were of no effect. The boundary question between Switzerland and Italy, submitted to the arbitration of George P. Marsh, United States minister to Italy, was decided on Sept. 23, 1874, in favor of Italy, definitely fixing the Swiss frontier at the point called the Cravaviola Alps, and was promulgated as obligatory on the two countries, June 11, 1875. In 1875 Switzerland and Italy concluded a new commercial treaty for ten years. —The principal works on the history of Switzerland are: *Geschichte der schweizerischen Eidgenossenschaft*, by Johannes von Müller and others (7 vols., 1780–1829), to the end of the 16th century, continued in a French translation by Monnard and Vulliemin to the 19th century (19 vols., Paris, 1837–'51); Heinrich Zschokke's *Geschichte des Schweizerlandes* (Zürich, 1822; English translation by Francis George Shaw, embracing Emil Zschokke's continuation to 1848, New York, 1855; new ed., 1875); Bluntschli's *Geschichte des schweizerischen Bundesrechts* (2 vols., Zürich, 1846–'52); and A. Morin's *Précis de l'histoire politique de Suisse* (5 vols., Geneva, 1855–'75).

**SWITZERLAND**, a S. E. county of Indiana, bordering on Kentucky, from which it is separated by the Ohio river; area, 220 sq. m.; pop. in 1870, 12,134. The surface is undulating and the soil fertile. The chief productions in 1870 were 132,865 bushels of wheat, 15,020 of rye, 309,183 of Indian corn, 27,970 of oats, 126,116 of potatoes, 19,446 tons of hay, 20,964 lbs. of wool, 174,821 of butter, and 17,342 gallons of sorghum molasses. There were 3,526 horses, 2,626 milch cows, 3,225 other cattle, 8,473 sheep, and 9,407 swine; 7 manufactories of carriages and wagons, 7 of cooperage, 1 of woollen goods, 6 flour mills, and 8 saw mills. Capital, Vevay.

**SWORD**, a weapon used in hand encounters, commonly made like a large knife, and sometimes pointed like a dagger. The ancient Egyptians possessed the art of imparting to bronze extraordinary hardness and elasticity, and employed this material for swords and daggers. Wilkinson describes the former as straight and short, from 2½ to 3 ft. in length, having generally a double edge and tapering to a sharp point. The Greeks had several varieties of swords of bronze, and at a later period of iron; and as seen upon coins, vases, &c., they appear to have been short cut-and-thrust blades, leaf-shaped or tapering from hilt to point, and provided with a scabbard, which was attached on the left side to a belt suspended from the shoulder or round the waist. The Lacedæmonian sword was curved on the sharp side, while the back was blunt, and the end was pointed obliquely toward the back. The Romans first used the Gallic sword, which had no point and was sharp on one side only; but after the battle of Cannæ they adopted the Spanish sword, which was short and straight, made for cutting and thrusting. The Gallic sword was worn on the left side, the Spanish always on the right. The swords used by barbarian soldiers and by gladiators were curved.

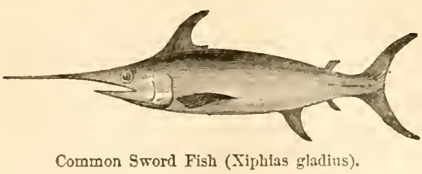



1. Greek Sword, from a Monument. 2. Greek Sword in the Royal Antiquarium, Berlin. 3. Lacedæmonian Sword, from a Vase. 4. Greek Sword in Scabbard, from a Vase. 5. Barbarian Sword, from the Column of Antoninus. 6 and 7. Roman Swords, in the Museo Nazionale, Naples.

The most famous swords were the Damascus blades of the middle ages, made probably of East Indian wootz, on the shores of the Mediterranean. (See DAMASCUS BLADES.) Next to these the swords of Toledo in Spain attained celebrity. Milan also was famous for its excellent swords during the middle ages. A manuscript psalter of the time of King Stephen gives a representation of two men grinding a sword blade, and there is no doubt of the early manufacture of swords in England. In the 17th century those made by the Germans were in good repute, and about the year 1689 unsuccessful efforts were made to establish the manufacture in Cumberland, England. In 1786 Mr. Gill of Birmingham, competing with German and English makers for supplying the East India company, produced a large number which bore the required test of bending till the length of the blade was reduced from 36 to 29½ in. Swords are still made at Toledo of as good quality as ever, but the manufacture employs only 70 or 80 hands. —The best of cast steel is required for good swords. The bars are hammered down by two men striking alternately; and if the blade is to have concave sides or other peculiarities of shape, these are obtained from the dies in which it is swaged. When shaped, it is hardened by heating in the fire to dull red and dipping point downward in a tub of cold water. It is tempered by drawing it through the fire until it acquires a blue color, and is then set or straightened by springing it with

the tongs in any required direction as it is held in a sort of fork standing in the anvil. After this it is ground upon a stone with a face adapted to that of the sword, flat or otherwise; is slightly heated to restore the temper impaired by grinding; and is finally polished with emery and crocus.—The small sword used in fencing is a slender weapon for the thrust only, and is the court dress sword. The broad sword, called sometimes the back sword, has but one edge.

**SWORD FISH,** the name of the *xiphiidæ*, a family of marine spiny-rayed fishes, allied to the mackerels, so called from the prolongation of the snout into a long, horizontally flattened, sword-like weapon. The sword consists of the vomer and intermaxillary bones, supported at the base by the frontals, nasal, and upper jaw. In form this fish resembles the mackerel; the scales are very small; the jaws proper, and sometimes the sword, are crowded with small, acute teeth, often hardly perceptible; the laminæ of each branchial arch are united into a band-like organ, with only superficial marks of separation, as in no other bony fishes; branchiostegal rays in the typical genus *xiphias* (Linn.) seven. The spinous dorsal begins near the head, high and sickle-shaped, extending nearly to the tail, and followed by a small soft fin; the anal is similar, but much shorter; ventrals wanting, or represented only by a pair of spinous rays on the throat; caudal deeply forked, on the sides having one or two large cutaneous folds; the pyloric appendages are collected into bundles and connected by areolar tissue, the branches forming two trunks inserted into the intestine close to the pylorus; the stomach cæcal and conical, and the air bladder large; the lower jaw in the young is proportionally longer than in the adult; the sclerotic forms a bony box, with a circular opening in the front for the cornea, rendering the eyes very movable. They are very swift swimmers, and feed on mackerel and other fishes collecting in shoals. The common sword fish (*X. gladius*, Linn.) attains a length of 12 to 20 ft., and is found in the Mediterranean and on both sides of the Atlantic; it uses its sword to destroy its enemies, and sometimes strikes at vessels, burying its weapon deep in their timbers. There are no ventral fins, and the sword is



Common Sword Fish (Xiphias gladius).

about three tenths as long as the body. It occurs on the North American coast from Nova Scotia to New York, being common in the summer in Vineyard sound and between No Man's Land and Block island; it is silvery white below, and tinged above with blackish blue, the sword dark brown above and lighter below. It is fond of pursuing the shoals of mackerel, and may be detected by the dorsal fin projecting above the water. They are taken by means of harpoons. The flesh is esteemed as food, both fresh and salted.

**SYBARIS,** an ancient Greek city of Lucania, in S. Italy, on the W. shore of the Tarentine gulf, between the rivers Crathis (now Crati) and Sybaris (Coscile), a short distance from the sea. It was founded by an Achæan colony about 720 B. C. The surrounding country was very fertile, and having large accessions from native Italian tribes, freely admitted to citizenship, the city rose rapidly to great wealth and power. When most prosperous, about 200 years after its foundation, Strabo says it was 50 stadia in circumference, ruled over 25 subject cities, and could muster an army of 300,000 men; while the knights in their religious processions numbered 5,000, or four times as many as the same class of citizens in Athens. Sybaris founded Posidonia, Laus, and Scidrus, and traded extensively. Its citizens were famed for effeminacy and love of luxury. Athenæus said no craft was permitted in the city which made a noise that might disturb the citizens; yet the arts conducive to pleasurable life were amply fostered. The aristocracy ruled till about 510 B. C., when Telys, a demagogue heading a democratic party, drove out the wealthier citizens and rulers, and raised himself to the position of tyrant. Of the exiled nobles 500 took refuge at Crotona, and Telys demanded their surrender. This was refused, and a war ensued in which a large army of Sybarites was beaten by one third the number of the Crotoniats, who sacked Sybaris, and turned the course of the river Crathis so that the city was inundated and buried in the deposits that the river brought down. Sybaris was never restored; its site is now a malarious marsh, and its exact position cannot be determined. Its surviving inhabitants, after remaining for many years at Laus and Scidrus, founded near it, with Athenian colonists, the city of Thurii.

**SYBEL, Heinrich von,** a German historian, born in Düsseldorf, Dec. 2, 1817. He studied in Berlin under Ranke, graduated in 1841 at Bonn, and was professor there in 1844–'5, then at Marburg till 1856, and subsequently at Munich, where he founded the first historical seminary established in Germany. He resumed his chair at Bonn in 1861, and in 1875 was appointed director of the archives at Berlin. In 1862–'6 he was a member of the Prussian chamber, and in 1867 of the constituent Reichstag of the North German confederation. His works include *Geschichte der Revolutionszeit* 1789–'95 (3 vols., Düsseldorf, 1853–'7; English translation by Perry, London, 1868; new ed., continued to 1800, 5 vols., Düsseldorf, 1874 *et seq.*); *Kleine historische Schriften* (2 vols., Munich, 1862–'9); *Die deutschen und auswärtigen Universitäten* (enlarged ed.,

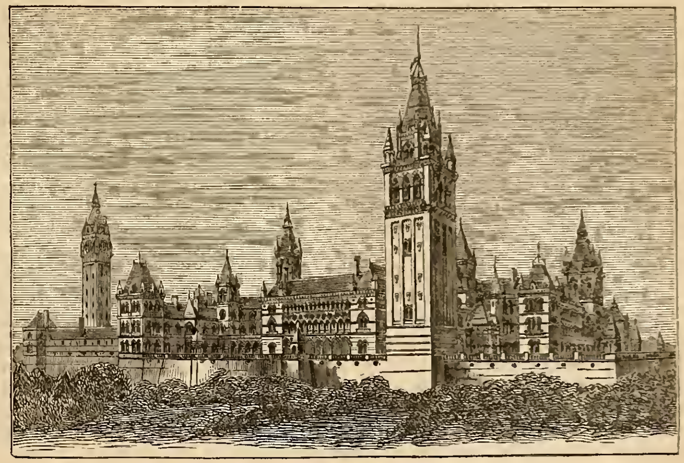
Bonn, 1874); and *Klerikale Politik im neunzehnten Jahrhundert*, in defence of Prince Bismarck's policy (1874; English translation by J. S. Henderson, London, 1874).

**SYCAMORE**, a name properly belonging to a species of fig (*ficus sycomorus*), the συκόμορος of the Greeks, and the plant so called in the Scriptures. The tree is common in Egypt; its light and durable wood was formerly used for mummy cases, and it is now planted as a shade tree and for its fruit. In the sacred dramas in the middle ages, the true sycamore not being at hand, the large maple was used to represent the tree into which Zacchæus climbed, and that in which the Virgin hid with the infant Jesus to avoid the fury of Herod. From this use the name sycamore was transferred to the maple (*acer pseudoplatanus*). (See MAPLE.) In the United States the plane or buttonwood tree is frequently called sycamore, as the leaves resemble in shape those of the sycamore maple.

**SYDENHAM, Floyer**, an English scholar, born in 1710, died April 1, 1787. He was educated at Oxford, where he took the degree of M. A. in 1734. He translated the greater part of Plato's works (3 vols. 4to, 1759–'80). Thomas Taylor completed the translation in 1804. Sydenham also published "A Dissertation on the Doctrine of Heraclitus" (1775), and *Onomasticon Theologicum* (1784). His sufferings from poverty in his old age, and his death in the debtors' prison, led to the foundation of the literary fund.

**SYDENHAM, Thomas**, an English physician, born at Winford Eagle, Dorsetshire, in 1624, died in London, Dec. 29, 1689. He graduated at Oxford, and in 1648 obtained a fellowship in All Souls' college, and studied there some years, visiting France in the mean while and attending the lectures of Barbeyrac. About 1660 he went to Westminster, and soon obtained a large practice and great reputation. Abandoning the routine system then in vogue, he based his practice on principles which recognize that there is in the human system a recuperative power, the *vis medicatrix naturæ*, and that this should be aided, not thwarted. He was the first who treated smallpox with cooling remedies, or intermittent fever with cinchona. The preparation known as Sydenham's laudanum was one of many valuable additions which he made to the materia medica. A collective edition of his works in Latin was published in London in 1785 (English translation, 1696).—In 1843 a society, composed mainly of members of the medical profession, was founded in London under the name of the Sydenham society, having for its object the republication of the works of Sydenham and of other eminent physicians of former times, otherwise inaccessible to professional readers in general, and published his works translated from the Latin by R. G. Latham (2 vols., London, 1848–'50).

**SYDNEY**, a city of Australia, capital of the colony of New South Wales, in Cumberland county, on the S. shore of Port Jackson, about 4 m. from its entrance, 450 m. N. E. of Melbourne; lat. 33° 51′ S., lon. 151° 14′ E.; pop. in 1871, 75,945, or including the suburbs, 134,758. Part of the town stands on a promontory, with Darling harbor on the W.; part occupies a narrow valley E. of this; and the remainder is on undulating ground extending S. and still further E., with extensive water frontage on the N. and N. E. The greatest length of the city is 3⅜ m. N. and S., and its breadth 2¼ m. E. and W. The total length of the streets is 115 m., and the number of houses 14,500. The main streets are laid out at right angles, but many are crooked and narrow, giving the city the appearance of an old English town. It is well supplied with water and lighted with gas. Public traffic is carried on by about 600 omnibuses and hackney coaches, and 30 steam ferry boats connect with the transmarine suburbs. Most of the public buildings, banks, and warehouses are of freestone in the Italian composite style. The exchange in the Corinthian, the government house in the Tudor, and the university in the perpendicular English style, are fine specimens of architecture. The new post office, opened in September, 1874, and the town hall, which is very large, are imposing edifices. Other noteworthy buildings are the new railway station, the courts of justice, the parlia-



Parliament Buildings, Sydney.

ment buildings, and the treasury. There are two cathedrals, Anglican and Roman Catholic, and about 120 other churches and chapels. There are three theatres, spacious markets, and several parks and gardens. Hyde park contains 40 acres, the Domain 138 acres, and the botanical gardens, the finest in the colonies, 38 acres. Prince Alfred park, Belmore park, and Moore park (500 acres) have all been recently laid out on the S. and S. E. sides of the city. Sydney is the residence of an Anglican bishop, who is the metropolitan of the Australian dioceses, and of a Roman Catholic archbishop. Connected with the university, whose degrees confer the same rank as those of the English universities, are St. Paul's Anglican college, St. John's Roman Catholic college, a Presbyterian college, and a Wesleyan college. There are also a normal school, a nautical school, many public and private schools, a free museum, a free public library, an observatory, three daily newspapers, and twelve weekly and eight monthly periodicals. Since 1855 a branch of the royal mint has been established here. The harbor is completely landlocked, and the largest vessels can come close to the wharves; and extensive ship yards and dry docks furnish every facility for repairing vessels. The port is well defended by several forts and batteries. The entrances at Port Jackson in 1872 were 1,022 vessels, tonnage 418,164; clearances, 854, tonnage 360,735. The exports to the United States for the year ending Sept. 30, 1874, amounted to $335,465. —Sydney was founded in 1788, and named in honor of Viscount Sydney, the colonial secretary of state. It was incorporated in 1842. In 1875 an intercolonial industrial exposition was held there.

**SYDNEY,** a port of entry and the capital of Cape Breton co., Nova Scotia, the chief town of the island of Cape Breton and its capital when a separate colony, situated in the E. part of the island, 195 m. N. E. of Halifax; lat. 46° 18′ N., lon. 60° 9′ W.; pop. in 1871, 2,900. The harbor is one of the finest in the world. In the vicinity are rich mines of bituminous coal, which are connected with the town by railway. There is considerable trade with Newfoundland and St. Pierre. Sydney contains an iron foundery, a tannery, a boot factory, ship yards, three branch banks, a court house, a masonic hall, a weekly newspaper, and churches of six denominations. The value of imports for the year ending June 30, 1874, was $70,554; exports, $588,935.

**SYDOW, Karl Leopold Adolf,** a German theologian, born in Berlin, Nov. 23, 1800. He studied under Schleiermacher, and was chaplain at Potsdam from 1837 to 1846, and for the last 30 years has been pastor of the *Neue Kirche* at Berlin. He was arraigned in 1872 for heresy, and was censured and fined, but retained his pastorate. Jointly with F. A. Schulze he has translated into German a collection of Channing's works (15 vols., Berlin, 1850–'53).

**SYENE.** See ASSWAN.

**SYENITE.** See GRANITE.

**SYLLA.** See SULLA.

**SYLLABUS** (Gr. σνλλαβός, a collection), the title given to a list of 80 propositions condemned at various times as erroneous by Pope Pius IX., which was sent by his order to the Roman Catholic hierarchy, Dec. 8, 1864. Several previous popes had condemned at one and the same time a series of propositions or heads of doctrine held to be heterodox or dangerous. Such were the 5 propositions containing the principal tenets of the Waldenses, condemned in 1318 by John XXII.; 21 from Huss, Wycliffe, and Jerome of Prague, condemned by Martin V. in 1418; 6 on the sacraments, from the writings of Peter de Osma, proscribed in 1481 by Sixtus IV.; 41 from the works of Luther and the early reformers, condemned in the bull *Exsurge, Domine*, by Leo X. in 1520; 76 from Baius, proscribed successively by Pius V., Gregory XIII., and Urban VIII.; 5 from the *Augustinus* of Jansenius, condemned by Innocent X. in 1653; 101 relating to Jansenism, condemned by Clement XI. in the bull *Unigenitus* in 1713; and 85 from the acts of the synod of Pistoja (1786–'7), condemned by Pius VI. in 1794. Pius IX. was moved to a similar act by a pastoral letter issued by Bishop Gerbet of Perpignan in July, 1860, censuring 85 propositions taken from various contemporary writers. On reading this document, the pope commissioned some Roman theologians to draw up a list, with references, of the errors which he had denounced during the 18 preceding years, in his consistorial allocutions or in his official letters. This list was annexed to the bull *Quanta cura*, issued Dec. 8, 1864, and communicated to the hierarchy by Cardinal Antonelli. In the bull, coming soon after the convention of Sept. 15 between France and Italy, the suppression of religious orders, and the confiscation of church property in Italy, the pope recalled the censure pronounced in the consistorial allocutions of Nov. 9, 1854, and June 9, 1862, against certain capital errors of the day, regarded as "the sources of all others" detrimental to civil society and to the church, and "opposed to the natural law written on the heart and in the very reason of man." He then formally condemned as erroneous various current doctrines, which inculcate that the perfection of civil government and social progress imperiously require that religion shall be ignored in the constitution and administration of states, or that no distinction shall be made between true and false religion; that the best government is that which represses or punishes acts committed against the Catholic religion only when these disturb the public peace, and that the most unlimited freedom of uttering one's opinions on every subject in public or in private, by writing or in print, shall be deemed an inherent right of every citizen in every form of government;

that the popular will, as expressed in public opinion or otherwise, is the supreme law, independent of all other, divine or human; and that in the political order accomplished facts, as such, have the force of right. Next came errors relating to the constitution and rights of the family, especially such as aim at refusing religious bodies all control over or share in education; the denial to the church as founded by Christ of all proper authority or jurisdictional rights, distinct from or independent of the state; the denial of power in the church to bind the conscience by any laws of hers, save only in so far as these are promulgated by the state; the denial of any validity to spiritual penalties decreed against secret societies in states which tolerate their existence, or of force in excommunications pronounced against persons usurping property belonging to the church, to religious orders, or ecclesiastical corporations, &c. This bull and the syllabus are to be taken as one authoritative act, the 80 errors designated in the latter being grouped under ten different heads, including pantheism and its adjuncts naturalism and absolute rationalism, moderate rationalism, and religious indifferentism; 20 propositions adverse to the constitution and rights of the church, 17 on civil society and its relations to the church, 10 on Christian marriage, 2 on the temporal princeship of the pope, and 4 on modern liberalism in its bearings on religion.—The appearance of both these documents created much excitement in France, where Jules Baroche, the minister of public worship, issued on Jan. 1, 1865, a circular letter to the French bishops forbidding the publication by them of the syllabus and of the doctrinal part of the bull. The liberal French press and the government journals also attacked these wide condemnations as "an act subversive of social order," "a monstrous error in politics as well as in the intellectual and moral order," "an attempt to restore an absolute theocracy, to set up a tyranny over everybody and everything." The minister declared the doctrine of the pope to be "contrary to the principles on which the empire reposed," and the *Journal des Débats* translated and analyzed the propositions condemned. Bishop Dupanloup replied to the latter, pointing out over 70 mistranslations and misconceptions; while nearly all the French prelates, including Archbishop Darboy, replied to the former, denouncing the ministerial prohibition. The bishop of Belley and the cardinal-archbishop of Besançon read both documents from the pulpit, and were prosecuted by the government. Elsewhere, though the proceeding of Pius IX. was generally condemned by the secular press, the civil governments did not feel called upon to interfere with the bishops, for whose special guidance the syllabus had been drawn up. In the beginning of 1871 Dr. Schulte, professor of canon and German law in the university of Prague, in a pamphlet entitled "The Power of the Roman Popes over Princes, Countries, Peoples, and Individuals," assumed that the syllabus with all its 80 propositions was an utterance *ex cathedra*, as defined by the council of the Vatican. This assumption, as well as the whole argument of Dr. Schulte, was assailed by Bishop Fessler of St. Pölten in Lower Austria, who had been secretary of the council, in his "True and False Infallibility of the Popes" (Vienna, 1871; English translation, London and New York, 1875), for which he received a congratulatory letter from Pius IX. In the autumn of 1874 the doctrines condemned in the syllabus were brought prominently before the public by Mr. Gladstone's pamphlet, "The Vatican Decrees in their Bearing on Civil Allegiance." From the syllabus and the bull *Quanta cura* he selected 18 propositions bearing principally on the liberty of the press, of conscience, worship, and speech, on the essential rights of both church and state, and their mutual subordination, on education, marriage, the abolition of the pope's temporal power, tolerance, and the reconciliation of the papacy with modern liberalism. The interpretation of the various propositions by Mr. Gladstone, and his conclusions therefrom, drew forth replies from Dr. Newman, Cardinal Manning, and other Roman Catholic writers, who accused him of mistranslating several propositions and misstating their sense. With regard to the doctrinal authority both of the bull *Quanta cura* and of the annexed syllabus, it is generally admitted by Roman Catholic theologians that the former has the character of an *ex cathedra* utterance, while the specific character of the latter is still a matter of dispute. All agree that the propositions condemned are erroneous, and that the condemnation should be accepted by all Catholics as final, while it is maintained by some that the syllabus has the same official and doctrinal value as the bull itself, and by others that the list of errors is only compiled for the convenience of bishops and theologians, each proposition bearing only that censure pronounced on it specially in the original document.

**SYLVESTER**, the name of two popes, besides an antipope. **I. Sylvester I., Saint**, born in Rome about 270, died there, Dec. 31, 335. He succeeded Pope Melchiades Jan. 31, 314, and concurred with the emperor Constantine in convening the council of Nice. (See NICE, COUNCILS OF.) He is frequently mentioned in history in connection with the "donation" said in the false decretals to have been made to him by Constantine of Rome and its temporalities. His feast is held on Dec. 31. **II. Sylvester II., Gerbert**, born at Aurillac in Auvergne about 920, died in Rome, May 12, 1003. He was a Benedictine monk of St. Gérold, Auvergne, studied under Hatto, archbishop of Vich in Catalonia, and at Rheims, and opened in that city a university course under the patronage of the emperor Otho II., which became famous throughout Europe. He constructed

terrestrial and celestial globes to illustrate his lessons, and a steam organ to explain his lessons on music; and he is said to have introduced the use of the Arabic figures in arithmetic, and to have invented the first wheel and weight clock. He was subsequently appointed abbot of Bobbio by Otho II.; but being unable to agree with the monks, he returned to Rheims after the death of Otho, resumed his teaching, and became secretary to Archbishop Adalberon of Rheims, and his successor through a contested election. He was deposed by Pope John XVI., and fled to the court of Otho III., who made him archbishop of Ravenna and had him elected pope, April 2, 999. He displayed uncommon zeal, talent, and severity in his administration. His universal knowledge caused him to pass for a magician. His letters, numbering 149, were published by Papire Masson (4to, Paris, 1621), and by André Duchesne in vol. ii. of his *Historiæ Francorum Scriptores.* His complete works are published in vol. cxxxix. of Migne's *Patrologie latine.*—See Bzovius, *Silvester II.* (4to, Rome, 1629); Hock, *Gerbert, oder Pabst Sylvester II. und sein Jahrhundert* (Vienna, 1837; French, Paris, 1842); and Milman, "Latin Christianity," vol. iii.

**SYLVIUS, Jacobus,** the Latinized name of a French anatomist, JACQUES DU BOIS, born at Louville, near Amiens, in 1478, died in Paris, Jan. 13, 1555. He graduated as A. B. in 1531, delivered lectures, and was appointed professor of medicine in the royal college of France in 1550. He is said to have originated the practice of injecting the blood vessels to facilitate their dissection. The oblique fissure separating the anterior and middle lobes of the cerebrum is called from him the fissure of Sylvius.

**SYMBOLS, Chemical,** abbreviations of the chemical names of the elements, which are combined into formulas, with or without quantitative signs, to represent the composition of compound bodies. The idea of representing the names of chemical substances by conventional signs or abbreviations appears to be a very old one. The alchemists were in possession of a set of hieroglyphics by which the metals and the four so-called elements, fire, air, earth, and water, and indeed many other substances, were designated. At a later period, as chemical knowledge became more consolidated, various modifications of the alchemistical notation were from time to time proposed, and adopted to a greater or less extent. Among these should be specially mentioned the system of notation offered in 1787 by Hassenfratz and Adet, as an appendix to Guyton de Morveau's revised system of nomenclature, since its failure enables us the better to appreciate the peculiar excellence of the system which now prevails. Here was a system of symbols by no means devoid of ingenuity, and much more complete than any previous method, published in connection with a new system of nomenclature, which was soon universally adopted, and recommended by the committee of the French academy by whom this nomenclature had been prepared; yet it met with little or no favor among chemists, and was soon forgotten. This last remark applies as well to the symbols proposed by Dalton in 1808, in connection with his writings upon the atomic theory. None of these systems ever came into general use, nor does it appear that they were of much value as instruments of study even in the special cases in which they were employed. It is to Berzelius that chemical science is chiefly indebted for the simple and rational system of notation now in use, which has done so much to advance knowledge and to lighten the labors of chemical investigators. This system, in its first outlines at least, appears not to have been the result of any premeditated plan or special study, but to have followed incidentally as a natural result from the investigation of the combining proportions of bodies with which its author was occupied. Thus in 1814 he first mentions his symbols in a foot note to a memoir upon nitrous acid (Gilbert's *Annalen der Physik*, xlvi., 154), as convenient abbreviations for expressing the composition of bodies, which he has himself frequently employed in his private memoranda. Subsequently a more complete exposition of the plan appeared in his *Lehrbuch*, and in Poggendorff's *Annalen*, 1826, viii., 7. As a sign to express the name and combining equivalent of an element, Berzelius chose the initial letter of its Latin name; and in those cases where the names of several elements commence with the same letter, he annexed to the common initial the first of the following letters in the Latin name of the element which is peculiar to it; thus, the symbol C indicates an equivalent of carbon, Cl an equivalent of chlorine, and Cr an equivalent of chromium. (For a complete list of these symbols, see EQUIVALENT, CHEMICAL.) There are various other symbols used in chemistry, some to express qualities as well as the atoms or molecules of substances, as, for instance, the signs which express the quantivalence of bodies. (See ATOMIC THEORY, vol. ii., p. 88.) The signs +, —, and = are also used in chemical writing for the purpose of joining the symbols of the elements together in formulas, as $K_2O + H_2SO_4 = K_2SO_4 + 2H$, or $C_6H_{12}O_6 - H_2O = C_6H_{10}O_5$. When united by the sign = the formulas are called equations. Thus the latter formula is an equation which represents starch as being formed from the elements of glucose or grape sugar, by the abstraction of a molecule of water or of the elements of such molecule. The quantity of any substance is usually expressed by placing a numeral before it, whether the substance is an element or a compound, unless where the numeral is used to express the number of separate elements or substances which enter into the composition of

a compound. Thus 3H signifies three atoms of hydrogen, and $3H_2O$ three molecules of water, one molecule of water being composed of two atoms of hydrogen and one of oxygen. The prefixed numeral however only includes those symbols which are not separated by a + sign or a comma, or which are included in parentheses; as $2KCl,PtCl_4$, which is the formula of potassic-platinic chloride, and which contains two molecules of chloride of potassium united to one molecule of tetrachloride of platinum. Two molecules of potassic-platinic chloride would be written $2(2KCl,PtCl_4)$. A numeral placed at the right of a symbol and a little below (or sometimes above) multiplies that symbol only. Thus, the formula of sulphuric acid, $H_2SO_4$, signifies that it contains two atoms of hydrogen, four of oxygen, and one of sulphur. A numeral placed in the same position with regard to any number of symbols placed in parentheses has the same function. Thus $(H_4N)_2CO_3$, which is the formula of normal ammonic carbonate, indicates that two molecules of the compound basyle ammonium, $H_4N$, are united to one molecule of the oxion $CO_3$, or carbion. A capital letter with a dash above it is often used to stand for a compound instead of an element, as $\bar{A}$ for acetic acid, $C_2H_4O_2$; $\bar{O}$ for oxalic acid, $C_2H_2O_4$. Other symbols and abbreviations are also given in the article ATOMIC THEORY.

**SYME, James,** a Scottish surgeon, born in Edinburgh in 1799, died there, June 26, 1870. He received his diploma as surgeon in 1821, and in 1823 became a fellow of the royal college of Edinburgh, and in 1843 of the English college of surgeons. From 1821 to 1833 he lectured on surgery, and in 1833 was appointed to the chair of clinical surgery at Edinburgh. He originated or aided in establishing many improvements, including the resection of diseased joints in place of amputation (a practice already introduced by Roux in 1812), the process for amputation of the foot at the ankle joint (known as "Syme's operation"), and the removal of large tumors of the lower jaw by exsection of the entire bone. His works include "The Excision of Diseased Joints" (1831), and "Principles of Surgery" (1832), both republished in Philadelphia (1866).—See "Memorial of the Life of James Syme," by Robert Paterson, M. D. (Edinburgh, 1871).

**SYMMACHUS, Cœlius,** a pope and saint, born at Sinagia in Sardinia about 440, died in Rome, July 19, 514. He was appointed archdeacon of the Roman church by Pope Felix III., and was elected to succeed Anastasius II., Nov. 22, 498. A strong minority of Eutychians, headed by the patrician Festus and favored by the Greek emperor Anastasius I., elected at the same time the archpriest Laurentius, who had consented to sign the *Henoticon* of the emperor Zeno. The claims of the two parties were referred to the arbitrament of Theodoric, king of Italy, who decided in favor of Symmachus, Laurentius being appointed bishop of Nocera. A council held in Rome in March, 499, having enacted decrees against all bribery and intrigue in papal elections, the opposition was renewed, and Laurentius secretly returned to Rome. Symmachus was accused of peculation and adultery, and Rome became the scene of rioting and bloodshed. A council of all the Italian bishops was convened at Rome in 502, and Theodoric hastened thither to secure tranquillity. The pope was unanimously acquitted of the charges brought against him. In France the bishops declined to acknowledge the competency of a local synod to sit in judgment on their superior, and a third council met in Rome in 503, to which the emperor Anastasius (whom Symmachus had excommunicated) sent representatives, who accused the pope of Manichæism and of promoting sedition. Symmachus, through his legate Ennodius, declared that he had freely submitted to the judgment of the former bishops, proved that he had combated Manichæism, and promised to restore the emperor to his communion as soon as the latter ceased to protect Eutychianism. With the council ended the schism in Rome, but Anastasius persecuted all who sustained Symmachus. The latter published a treatise in which he refuted the charges against his doctrine and morality. His feast is held on July 19.

**SYMMACHUS, Quintus Aurelius,** a Roman author of the 4th century A. D. He was educated in Gaul, and, after being quæstor and prætor, was appointed in A. D. 365 corrector of Lucania and the Bruttii. In 373 he was proconsul of Africa, in 384 prefect of Rome, and in 391 consul. He was a sincere pagan, and labored to maintain his faith. His extant works are 10 books of epistles containing 965 letters, and fragments of orations which Angelo Mai discovered in one of the palimpsests of the Ambrosian library, and others from a Turin and Vatican manuscript. The first edition of the epistles was published in the pontificate of Julius II. One of the best is that of Scioppius (4to, Mentz, 1608).

**SYMMES, John Cleves,** an American soldier, born in New Jersey about 1780, died at Hamilton, Butler co., Ohio, May 28, 1829. He entered the army as ensign in 1802, fought in the war of 1812, settled at Newport, Ky., and wrote and lectured on his theory that the earth is hollow, open at the poles, and capable of being inhabited within. He published "Theory of Concentric Spheres" (12mo, Cincinnati, 1826). For an abstract of Symmes's theory and arguments, see the "Atlantic Monthly" for April, 1873.

**SYMPATHETIC INK.** See INK, vol. ix., p. 284.

**SYMPHONY** (Gr. σύν, with, and φωνή, voice), a term originally signifying merely a concordance of tones, but applied successively to certain vocal compositions, to compositions partly vocal and partly instrumental, to short introductory or intermediate instrumental passages in compositions which are predominantly vocal, and finally to elaborate and extended com-

positions for instruments only and in the sonata form. In this sense the word is now generally used. The germ of the modern symphony may be found in the suites prefixed by Scarlatti to his operas, which he designated as the symphony, consisting of three movements: 1, allegro; 2, andante; 3, allegro. But it was not till the time of Haydn, called the father of the symphony, that this kind of composition took its present form. He added a fourth movement, the minuetto, and elaborated the whole structure of the symphony. He composed 118 works of this kind. The form that Haydn fixed upon was adopted by Mozart and Beethoven, the latter especially giving a breadth, dignity, and grandeur to his symphonies that have made them the masterpieces of this form of musical art. In the final movement of his ninth or choral symphony he introduced vocal music, an example which has not been followed by later composers. Mendelssohn, Gade, Reinecke, Liszt, and Raff are among the more modern composers of works of this class.

**SYMPLEGADES.** See Argonauts.

**SYNAGOGUE** (Gr. συναγωγή, assembly, place of assembly; Heb. *beth hakkeneseth*, house of assembly), a building appropriated to worship and the performance of public religious rites in Jewish congregations. Corresponding to the word church in Christian terminology, the term is also applied to the Jewish community in general. The earliest synagogues, established in the times of Persian and Greek rule in Judea, were also for deliberative purposes. (For the "great synagogue" or assembly see Hebrews, vol. viii., p. 591.) In subsequent centuries they were also used as seats of popular as well as higher instruction. In modern Jewish communities this is mostly imparted in a separate building, called *beth hammidrash*, house of study. The synagogue is generally a high building, facing the four cardinal points, and provided with seats and desks on the floor for the male members of the congregation, and with galleries for the females. The east wall, which all must face during the recital of certain prayers, encloses the "holy ark" (*aron hakkodesh*), in which Hebrew copies of the Pentateuch, written on vellum, are deposited; and opposite it, near the centre, is the platform (*bimah*) on which the reading from the same is performed by the reciter or cantor (*'hazan*), or by a special reader (*kore*). Sermons or lectures are delivered from a smaller platform adjoining the "holy ark," by the rabbi or a special preacher or lecturer. The offices of reciter, reader, and lecturer are often united in the same person. Of late the use of the choir has become frequent, and the internal arrangements of the synagogues have been more and more assimilated to those of Christian churches.

**SYNESIUS**, a philosopher of the 5th century, born in Cyrene, Africa, about 379, died at Ptolemais about 430. He was of an ancient Greek family, studied at Alexandria under Hypatia, and at Athens, and on his return to Cyrene devoted himself to literary pursuits. Famine having come upon Cyrene about 397, Synesius was sent to Constantinople to solicit aid, and was successful. After three years' stay in the Byzantine capital, he returned to Cyrene, and soon afterward, under the influence of a Christian wife, renounced paganism. In 410, on the death of the bishop of Ptolemais (now Tolmeta in Barca), Synesius was chosen to the see, although he had not been baptized, was married, and held opinions not regarded in the church as orthodox. He accepted the post with reluctance, was baptized, and after seven months of preparation entered upon his episcopal duties. He was a Neo-Platonist before he became a Christian, and during his episcopate explained Christian dogmas in the light of his philosophy, inclined to the preëxistence of the human soul, believed in its immortality, held the resurrection to be a myth, and conceived the Trinity as a triple-headed energy displaying the innate nature of the "unity of unities." His works consist of epistles, treatises, and hymns. The best complete collection of them is that of Petau, in Greek with a Latin translation, editions of which appeared at Paris in 1612, 1633, and 1640. A new and more critical edition was published by Krabinger (2 vols. 8vo, Berlin, 1851). Many editions of the hymns have been published with translations into various tongues. A French version first appeared in 1581, and new ones in 1836 and 1839. See also Migne's *Patrologie grecque*, vol. lxvi.; and Kolbe, *Der Bischof Synesius von Cyrene* (Berlin, 1870).

**SYPHAX**, a Numidian prince, born about 250 B. C., died in 201. In 213 he was king of the Massæsylians, the westernmost tribe of the Numidians, and was at war with Carthage, in which he was encouraged by the Romans. Carthage, however, induced Gala, king of the Massylians, to declare war against him, and Syphax was defeated by Hasdrubal and Gala's son Masinissa. Syphax fled to Mauritania and collected a new force, but was again defeated by Masinissa. He subsequently regained possession of his throne, and Hasdrubal, to prevent his yielding to the overtures of Scipio for an alliance, gave him his daughter Sophonisba in marriage. On the death of Gala, Syphax with Carthaginian aid wrested the throne from Masinissa, and made him a fugitive. When Scipio landed in Africa in 204, Syphax joined the Carthaginians with an army of 50,000 foot and 10,000 horse. He encamped in the vicinity of the Romans, and during the siege of Utica held prolonged negotiations with Scipio; but the latter suddenly fell upon his camp in the night, set fire to its straw huts, and nearly destroyed his army. Two more armies raised by him were defeated, and he was finally made a prisoner. Polybius says he appeared in Scipio's triumphal procession, but Livy denies it.

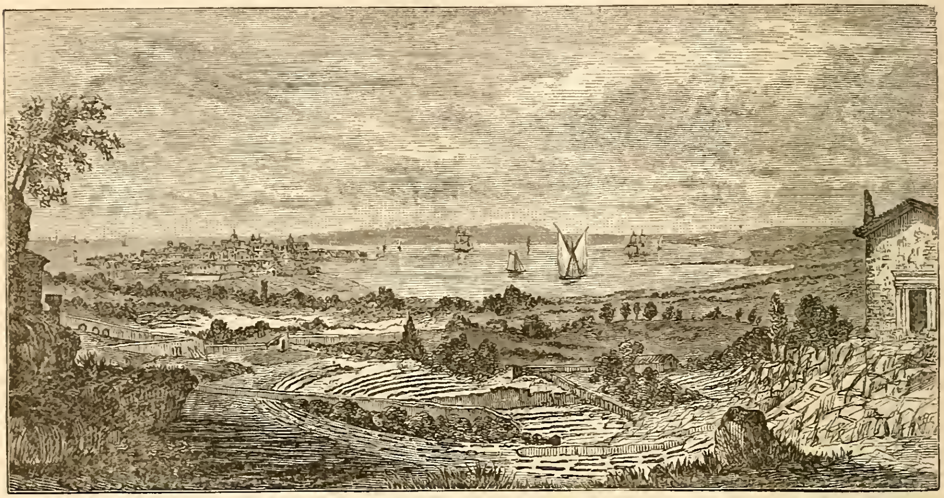
**SYPHILIS.** See Skin, Diseases of the, in Supplement, p. 883.

**SYPHON**, an inverted U-shaped tube used to draw liquids over the containing walls of reservoirs. It acts upon the principle that the flow will be in the direction of that leg which contains the greatest vertical height of liquid. The instrument will act only when the bend at the top is not higher above the level of the water in the reservoir than the atmospheric pressure at the locality is capable of sustaining a column of the liquid acted upon, which for water could only be a little over 33 ft. at the sea level, and at a height of 15,700 ft. less than 20 ft. (See PUMP, vol. xiv., p. 82.) If the liquid is mercury, the bend of the syphon could not be more than 29 or 30 in. above the level in the reservoir at the sea level. In practice the outer or discharge leg is usually longer than the one immersed in the liquid; but the only requirement is that its orifice shall be lower than the level of the liquid. It is convenient to have a suction pipe attached to the outer leg for producing exhaustion, the lower orifice in that leg being closed at the time.

**SYRA**, or **Syros. I.** A Grecian island, included in the Cyclades, 20 m. N. W. of Paros; area, 45 sq. m.; pop. in 1870, 26,480. It is of very irregular outline, with steep and rugged coasts. The chief productions are wheat, barley, cotton, figs, silk, and especially wine, whose praises have been sung by Homer. **II. Syra, New Syros**, or **Hermopolis**, the capital of the island and of the Greek nomarchy of the Cyclades, situated at the head of a bay on the E. coast, near the site of the ancient city; pop. in 1870, 20,996. It is the seat of a Roman Catholic bishop, and of the Greek bishop of the Cyclades. It is the principal commercial port of Greece and an important station for steamers. The imports in 1873 amounted to £791,500, and the exports to £172,337. The old part of the town, originally built on a hill as a protection against pirates, is inhabited chiefly by Roman Catholics, and the lower part by Greeks. At the close of the Cretan war in 1869, the port was blockaded by Hobart Pasha.

**SYRACUSE** (It. *Siracusa* or *Siragosa*). **I.** A province of Sicily, on the E. coast, bordering on Catania and Caltanisetta, and the Mediterranean; area, 1,429 sq. m.; pop. in 1872, 294,885. It is chiefly mountainous, but the south is a plain. The principal rivers are the Anapo, Abisso, and Ragusa. The valleys of these rivers, the bases of the mountains, and the districts along the coast are very fertile, and contain excellent pastures and some good timber. Agriculture and cattle raising are the chief occupations. The principal products are grain, barley, olives, wines, fruit, flax, and hemp. Among the mineral products are marble, agates, stalactites of various colors, and bitumen. The province is divided into the districts of Syracuse, Noto, and Modica. **II.** A city (anc. *Syracusæ*), capital of the province, on the E. coast, 30 m. S. S. E. of Catania, and 81 m. S. by W. of Messina; pop. in 1872, 22,179. It is fortified, and maintains a garrison, but is commanded by the heights of Achradina. It is the see of a bishop, and has a fine cathedral, partly on the site and partly composed of the ancient temple of Minerva, numerous palaces, and several churches and convents. The streets are narrow, and there are extensive ruins of amphitheatres, baths, &c. The city has some trade in wine, oil, brandy, fruits, salt, saltpetre, sulphur, and a little grain.—The ancient Syracusæ was the largest city of Sicily; its walls, flanked by towers, were about 22 m. in circuit, and the number of inhabitants in its most prosperous period is stated by different writers at 500,000, 900,000, and even 1,200,000. It really consisted of five towns adjoining each other, but separated by walls, viz., Ortygia, Achradina, Tyche, Neapolis, and the Epipolæ, and hence was sometimes called Pentapolis. The original city was Ortygia, on an oblong island about 2 m. in circuit, between the Great or Greek harbor on the west and the Little harbor on the east; after a time it was connected with the mainland by a causeway, and was then spoken of as Ortygia on the peninsula. Achradina, which was next in age, was on the other side of the Little harbor, and extended along the sea coast for about 3 m., E. of the port of Trogilus, without the limits of the city; it was built partly on the lowlands along the shore, and partly on the heights which rise in a wall of rocks some little distance inland. N. W. of Achradina and on the same range of heights stood Tyche, separated from it only by a double wall and a highway between; it extended northward about 2 m., and at its W. extremity were several heights named the Epipolæ, which were enclosed by Dionysius the Elder and formed one vast fortress. S. of Tyche, and opposite Ortygia, on the lowlands and extending to the wall of Achradina, at the foot of the heights, was Neapolis or the new town. W. and S. of Ortygia, around the marshy shores of the Great harbor as far as the rocky peninsula of Plemmyrium, were suburbs and gardens. After the Roman conquest, as the city declined in wealth and population, its limits became more restricted; at the time of Augustus it occupied only Ortygia and the lower part of Achradina, and since its capture by the Saracens it has been confined to the Ortygian peninsula. The heights of Achradina now present only a surface of rock, the ancient buildings and the soil having been alike removed. The sea has undermined the shore, the walls have disappeared, and over the elevated and extensive plain only steps hewn in the rock or a few courses of stone give evidence of the vast population which once inhabited it. On the peninsula and the lowland portion of Achradina and Neapolis, evidences of the former greatness of Syracuse are more abundant. Near the borders of Tyche, Achradina, and Neapolis is the ancient theatre hewn out of the rock and now much overgrown with bushes; it is 440

ft. in diameter, contained 60 ranges of seats, all cut in the rock, and could accommodate 24,000 spectators. Not far from this are the ruins of an amphitheatre of the Roman period. Nearer to Ortygia are the ruins of the palace of Agathocles, and on the peninsula are traces of several other palaces. The *lautumiæ* or *latomiæ*, originally quarries cut in the wall of rocks which formed the face of the heights of Achradina, and excavated to the depth of 60 to 80 ft., are still perfect. Some of them were used as prisons; in one the Athenian



Syracuse—Ruins of Theatre in the Foreground.

prisoners were confined on the surrender of Nicias, and most of them perished. Near the site of the ancient theatre, on one side of the quarry, is that remarkable prison cut in the rock, now called the "ear of Dionysius." There are also catacombs of great extent containing subterranean streets of tombs, in which Greek and Roman, Christian and Saracen, have all found burial. The remains of a great aqueduct begun by Gelon and improved by Hiero also exist. Near the left bank of the Anapo, outside the walls and S. W. of the city, are the ruins of the temple of Jupiter Olympius. The celebrated fountain of Arethusa, long in a ruinous condition and used by washerwomen, has been repaired and beautified by the city authorities; a wall separates it from the sea. There are also remains of several baths, one of them with a spiral staircase. In the museum of the modern city are preserved statues, vases, coins, and inscriptions gathered from the ruins.—Syracuse was founded by the Corinthians, under Archias, about 734 B. C. Within 70 years it began to send out colonies, among which were Acræ (664), Casmenæ (about 644), and Camarina (599). In 486 an oligarchy called the Geomori, or Gamori, who had usurped the government, were overthrown. They withdrew to Casmenæ, but Gelon, despot of Gela, restored them to power, reserving for himself the supreme government. (See Gelon.) Hiero, his successor (about 478), was a patron of literature and the arts. His brother Thrasybulus succeeded him in 467, but his tyranny soon caused his expulsion, and a popular government was instituted. (See Hiero.) In 415 the Athenians formed a league against Syracuse, and besieged it the following year. The Spartans came to the aid of the Syracusans, and in September, 413, a great naval battle was fought, in which the Athenians, under Nicias and Demosthenes, were defeated, their ships destroyed, about 30,000 men killed, and 10,000 made prisoners. In 405 Dionysius the Elder, taking advantage of the popular alarm at the aggressions of the Carthaginians, made himself despot of the city, concluded a peace with Carthage, and ruled vigorously but tyrannically for 38 years. He fortified the town, and in 397 commenced war against the Carthaginians, and defeated them. Twelve years later he had extended his dominion over the greater part of Sicily and a part of Magna Græcia. He was succeeded in 367 by his son Dionysius the Younger, whose tyranny and debauchery brought about his expulsion by Dion in 357; he regained his power in 346, but was finally expelled by Timoleon in 343. (See Dionysius.) The restoration of liberty to Syracuse by the latter was followed by unexampled though brief prosperity; and 26 years later Agathocles acquired despotic power over the city, and used it for 28 years to plunge her in new and destructive wars. (See Agathocles.) After his death (289) a short respite was had, but soon new tyrants assumed the sway, till in 270 Hiero II. obtained supreme power, and maintained a firm

and judicious administration for 54 years. In 263 he made a treaty with Rome, whose steadfast ally he thenceforward became. During his reign Syracuse attained to its highest splendor. With his death (216) a great change took place. His grandson and successor Hieronymus abandoned the alliance of Rome for that of Carthage, and after his death the Carthaginians brought about an open rupture with Rome, which led to the siege of Syracuse by Marcellus (214–212), a siege rendered illustrious by the patriotic efforts of Archimedes, but which finally resulted in the capture and plunder of the city. The magnificent works of art then carried as plunder to Rome gave the first impulse to the love of Greek art among the Romans. Syracuse fell into decay, and lost in wealth and population. Augustus in vain endeavored in 21 B. C. to restore it by sending a Roman colony. In the 4th century A. D., though much decayed, it was still one of the largest cities of Sicily. It fell into the hands of the Goths at the overthrow of the western empire, but was recaptured by Belisarius in 535, and remained a fief of the Byzantine emperors till 878, when, after a siege of nine months, it fell into the hands of the Saracens, who massacred its inhabitants, destroyed its fortifications, and burned the city. In 1088 Count Roger of Sicily made himself master of Syracuse. It was partially rebuilt and fortified by Charles V., but in 1542, 1693, and 1757 was nearly destroyed by earthquakes. On April 8, 1849, during the Sicilian insurrection, it surrendered to the Neapolitan fleet, and in 1860 it espoused the cause of Garibaldi.

**SYRACUSE,** a city and the county seat of Onondaga co., New York, at the head of Onondaga lake, on a creek of the same name, 147½ m. by the New York Central railroad W. by N. of Albany and 150½ m. E. of Buffalo; lat. 43° 3′ N., lon. 76° 9′ W.; pop. in 1850, 22,271; in 1860, 28,119; in 1870, 43,051, of whom 13,990 were foreigners, including 5,062 Germans and 5,172 Irish; in 1875, 49,808. The main portion lies in the valley of the creek, while the E. part is on two ridges, the summits being about 200 ft. above the lake. It is very regularly laid out; but few of the streets are less than 66 ft. wide, and many of them 99 ft., well shaded, with occasional small ornamented squares. The business portion is substantially built of brick; but the great majority of the dwellings are of wood, surrounded with lawns and gardens. The court house, of Onondaga dressed limestone, besides the usual court rooms, contains the library of the court of appeals (6,000 volumes); it cost $40,000. The city hall is of brick, on the N. side of a little park. The state armory, on Armory park (about two acres), is of brick, covers an area of 35,000 sq. ft., and cost $85,000. The Onondaga County savings bank is a fine building of Onondaga limestone in the renaissance style, costing $300,000. The Syracuse savings bank, in course of construction, is of Ohio buff sandstone with trimmings of New Jersey red sandstone. The first Presbyterian church, the costliest in the city, is of Fulton brown stone in the middle Gothic style, with a lofty spire. Syracuse university is on an elevation in the S. E. part of the city, with diversified grounds comprising 50 acres. The building is of rough dressed limestone ashlar, with fine cut trimmings in the Italian style, is 80 ft. by 180, and three stories above the basement. On a beautiful elevation just W. of the corporate limits of the city stands the New York state asylum for idiots, an elegant structure in the Italian style erected in 1855. (See IDIOCY, vol. ix., p. 174.) The principal cemetery is Oakwood, comprising about 150 acres, in a fine natural situation in the S. E. quarter of the city. It has been handsomely laid out, and contains many fine monuments.—Syracuse is an important railroad centre; 38 passenger and 60 freight trains arrive and depart daily. The diverging lines are as follows: the Oswego and Syracuse; Syracuse, Phœnix, and Oswego; Syracuse and Northern; New York Central; Syracuse and Chenango; Syracuse, Binghamton, and New York; and the Auburn branch of the New York Central. The Erie canal passes through the city, and the Oswego canal runs N. from near the centre. In 1874, 110,000 tons of freight, exclusive of wood and lumber, cleared at the collector's office. The controlling interest has always been the manufacture of salt. The springs were first visited by Jesuit missionaries in 1654, who made some salt and carried it to Quebec. From this time to the settlement of the whites in 1787 it was manufactured by the Indians and was an article of traffic. The manufacture has steadily increased since the settlement. In 1797 the state took control of the springs and passed laws for the regulation of the business. From 1797 to 1806 inclusive, 78,000 bushels were made; 1807 to 1816, 267,000; 1817 to 1826, 608,000; 1827 to 1836, 1,594,000; 1837 to 1846, 3,058,000; 1847 to 1856, 5,083,000. In 1874, 6,029,300 bushels were manufactured on the reservation, mostly in the city. There are 20 salt companies, which manufacture both by solar and artificial heat, employing a vast amount of capital and hundreds of men. There are about 90 other manufactories, producing articles in 1874 to the value of about $14,000,000. The most important are a blast furnace, Bessemer steel works, two rolling mills, three engine and boiler works, five founderies and machine shops, a bolt and nut factory, a manufactory of mower and reaper knives, a railroad journal-box factory, seven planing mills and sash, door, and blind factories, two fruit-canning establishments, an extension table factory, five manufactories of musical instruments (organs, pianos, &c.), one of picture frames, one of glass, two of matches, one of agricultural implements, one of mowers and reapers, three of saddlery hardware, three of boots and shoes, seven of ready-made clothing, many of cigars, two of

furniture, two of paper boxes, two of silver ware and jewelry, numerous barrel factories, seven breweries, three flouring mills, gas works, and six stone-dressing yards. There are five national banks, with an aggregate capital of $1,130,000; two state banks, capital $440,000; a trust and deposit company; two private banking houses, and three savings institutions, with upward of $7,000,000 deposits.—The city is divided into eight wards, and is governed by a mayor and a board of eight aldermen (one from each ward). It has an effective police force, a good fire department, water works, and street railroads. The assessed value of property is $12,310,937; funded debt of the city, $1,339,000. The principal charitable institutions are the county orphan asylum, St. Vincent de Paul's asylum for children, the "Home" for aged and indigent females, St. Joseph's hospital, and the house of the Good Shepherd. There are a high school and 15 other public schools, with graded departments and an average attendance of 6,434 pupils. The central library in the high school building, a free circulating library under the direction of the board of education, contains about 12,000 volumes.—Syracuse university was established by the Methodists in 1870, and opened in 1871. The plan is that of an assemblage of colleges of both undergraduate and professional grades, and three of these have been established, viz.: the college of the liberal arts, opened in 1871, which in 1875 had 11 professors and 148 students, and which confers degrees in the arts, philosophy, and science; the college of physicians and surgeons, established in 1872, which in 1875 had 15 professors and 60 students; and the college of the fine arts, established in 1873, which in 1875 had 8 professors and 22 students. The number of students in the several preparatory departments in 1875 was 142, making a total of 372 students. The library contains about 8,000 volumes. All the colleges are open to students of both sexes, who pursue the same courses of instruction in the same classes. While the responsibility of support and direction devolves mainly upon the Methodist Episcopal church, all sectarian differences are ignored, and attendance upon chapel exercises is not compulsory. In 1875 the assets of the university amounted to about $600,000, of which the city contributed $100,000, and the rest was derived from private subscriptions.—The Onondaga historical association, incorporated in 1863, has a library of 1,500 volumes and valuable cabinets. The young men's Christian association, organized in 1858, has an excellent library and reading room. There are three daily and eleven weekly newspapers, including two issued on Sundays. The number of churches is 41, viz.: 2 Baptist, 1 Church of Christ, 2 Congregational, 4 Episcopal, 1 Independent Christian, 3 Jewish, 5 Lutheran, 9 Methodist, 4 Presbyterian, 1 Reformed, 7 Roman Catholic, 1 Unitarian, and 1 Universalist.—The first settlement within the corporate limits was made by Ephraim Webster, an Indian trader, near the mouth of Onondaga creek, in 1787. In 1789 Asa Danforth settled in that part now known as the first ward, then called Salt point, and began the manufacture of salt. It soon took the name of Salina, and became the most important place in the county. The first settlement in the central portion of the city was made in 1797. It increased slowly, and assumed successively the names of Bogardus Corners, Milan, South Salina, Cossitt's Corners, Corinth, and Syracuse (in 1824). It was incorporated as a village in 1825. The Erie canal having been completed in that year, the rival villages of Salina and Syracuse rapidly increased in population, and in 1847 were consolidated in the city of Syracuse.

**SYRIA** (Turk. *Suristan;* Arab. *Esh-Sham*), a territory of Asiatic Turkey, bounded N. by Adana and Marash, E. by the Euphrates and the Syro-Arabian desert, S. by Arabia, and W. by the Mediterranean, between lat. 31° and 37° 20′ N., and lon. 34° and about 40° E.; area, about 60,000 sq. m.; pop. about 1,000,000. It includes parts of the vilayets of Syria (capital Damascus; area, inclusive of a part of the desert, 66,000 sq. m.; pop. in 1871, 518,750) and Aleppo, the latter including Marash and some districts E. of the Euphrates (area, 40,750 sq. m.; pop. 535,714). Besides the large gulf of Iskanderun (the ancient gulf of Issus), at the extreme north, which extends between Syria and Asia Minor, the coast is indented by several small bays, as those of Tripoli, Beyrout, Saida, and Acre. The principal rivers are the Jordan, the Asi or Aasy (the ancient Orontes), the Litany (Leontes), the Yarmuk (Hieromax), the Barada (supposed to be the Scriptural Abana), and the Awaj (Pharpar). The Euphrates drains the N. E. border. The only important lakes are the Dead sea and the lake of Tiberias or Gennesaret. The Taurus range forms a part of the N. boundary, and separates Syria from Asia Minor. The two parallel chains which extend through Syria from N. to S., the Libanus or Lebanon and the Anti-Libanus, are offsets of the S. W. continuation of that range known to the ancients as the Amanus (now Alma Dagh). The W. or Lebanon chain runs parallel to the coast, and seldom more than 12 m. distant from it, to the plain of Esdraelon below Mt. Tabor; it is broken by the passage of the Orontes and the Leontes. Its highest summits are 10,000 ft. above the sea. This chain contains the remnant of the ancient "cedars of Lebanon." Separated from this by a beautiful and fertile valley, Cœle-Syria, from 10 to 20 m. in width, is the Anti-Libanus chain, generally lower, though in its loftiest summit, Mt. Hermon, rivalling the highest peaks of the Lebanon range. E. of Hermon a chain of low mountains stretches eastward past Damascus; below it the country is hilly, and, viewed from the deep depression of the Jordan valley, seems mountainous. The mountains of Gilead E. of

the Jordan form the culminating point of these hills. Further E., in the Hauran, is a lofty table land, waterless, and with vast black bowlders and rocks scattered over its face. The most remarkable feature of the topography of Syria is the extraordinary depression of the valley of the Jordan. The valley of Cœle-Syria (now El-Bukaa), between the Libanus and the Anti-Libanus, is about 2,300 ft. above the sea; it formerly contained Heliopolis or Baalbek, and other great cities. Near its southern termination it divides into two branches, one cutting through the Lebanon range in the narrow gorge through which the Leontes finds its way to the sea, the other striking off southward and descending rapidly for 15 m. to the source of the Jordan at the base of Hermon. The continuation of the latter, the valley of the Jordan, descending with a steady but rapid slope, at the plain of Huleh is at the sea level; at the lake of Tiberias it is about 650 ft. below it; and within 60 m. of direct distance, though by the circuitous channel of the river 200 m., at the Dead sea, it is about 1,300 ft. below the Mediterranean. No similar river valley is known. Among the level tracts of Syria are the great plain of Esdraelon, that of Sharon, and the arid sandy plain of Gaza. Around Damascus, an oasis in the desert, vast plains of sand extend E. and S., and cover the region that contains the ruins of Palmyra.—The geology of Syria is interesting. In the extreme south are only primitive rocks, the variegated granite of the Sinaitic peninsula; the deep chasm of the Dead sea, with its bitumen pits, salt mountains, and warm springs, belongs to the carboniferous era; the calcareous and sandstone formations of Hermon and Lebanon abound in fossils of the era of the new red sandstone; and the porphyry and basalt of the Hauran give evidence of their igneous origin. The soil is exceedingly fertile wherever there are sufficient rains, or irrigation can be practised; but where there is no water, it is sandy and utterly barren. The region around the Dead sea is thoroughly impregnated with salt and alkalies, and is entirely devoid of vegetation. In the south and east there are vast sandy wastes. The mineral productions of Syria are iron of excellent quality, a little quicksilver and some coal in the south, and in the Dead sea region salt and bitumen. Good salt is also made on the shores of the Mediterranean.—There are few countries of the same extent in which the climate is so varied as in Syria. On the slopes of Lebanon it is cool and pleasant in the summer months, and in the winter heavy rains fall, but the cold is not severe. In the valley of the Jordan the summer heat is equal to that of the hottest portion of the tropics, and on the coast the summers are also very hot and unhealthful. In winter Beyrout and some of the other cities of the coast are favorable for invalids. In Jerusalem the heat is oppressive during the day in summer; rain seldom falls between the end of April and the beginning of October, and there are few clouds, and hence everything is parched till the rainy season. Damascus is colder in winter than the western slopes of Lebanon, and snow frequently falls; yet the orange and fig thrive there. The average range of heat in the hottest part of summer at Jerusalem and Damascus is from 84° to 86° F. In Aleppo the annual range is very great, the thermometer falling below zero in winter and rising above 100° in summer.—The implements and modes of agriculture are nearly identical with those in use 2,500 years ago. Still the crops, wherever there are rains or irrigation can be practised, are large. Wheat, barley, durra, and spelt are largely produced, as well as rice, lentils, peas, &c.; cotton, hemp, silk, madder, indigo, sesamum, castor oil, tobacco, potatoes, capsicum, melons, cucumbers, and artichokes are also important crops. Figs, olives, mulberries, grapes, almonds, apricots, peaches, pomegranates, oranges, lemons, dates, and other fruits abound. Vineyards are numerous on the mountain slopes and in the hill country of Judea; the grapes are large and luscious, and the wine made from them is excellent. Storax is produced for the market. In the vicinity of Damascus are extensive fields of roses, the petals of which furnish the attar of commerce. The sycamore, Indian fig, carob, mulberry, and pistachio trees grow abundantly, both wild and cultivated. Scammony and sumach are gathered about Mt. Lebanon for exportation. The cedar, pine, and fir are found in extensive forests on the mountains, though the true cedar of Lebanon, once so highly prized for building purposes, is nearly extinct. The arbutus, terebinth, laurel, and several species of juniper occur on the table lands, and also dwarf oaks which produce the best gall nuts. The domestic animals are horses, of which the wandering tribes possess breeds of extraordinary speed and beauty; cattle, generally small and inferior; asses and mules, large and very serviceable; sheep and goats of several kinds, the broad-tailed variety of the former being found only in N. Syria; camels throughout the country, and the domesticated buffalo on the coast and in the valley of the Orontes. Jackals, foxes, and hyænas are common in the desert mountains; the Syrian bear has his home in Mt. Lebanon; wolves and wild boars in the northern forests, and the latter also occasionally further S.; deer are also found in the north, and antelopes in the desert regions; and hares, porcupines, and jerboas are abundant. There are no poisonous serpents. Silkworms are reared extensively in the mountainous districts. Turtles and tortoises are found in considerable numbers. Fish are abundant in some of the inland lakes, though not plentiful along the coast of the Mediterranean. The manufactures are few and coarse. Beyrout is now the chief commercial city, and within 40 years its population has increased from 5,000 to 70,000.—

The inhabitants are of a great variety of races and religions. The ruling race are the Osmanli Turks, though they are but an insignificant portion of the Mohammedan population, who are mostly Arabs; they are bigoted and hostile to Christians, and are strict in their adherence to the Sunna or orthodox Islamism. There are four sects usually considered Mohammedan dissenters, though not all of them can properly be reckoned as Mohammedans. The Metualis are the followers of Ali, the son-in-law of Mohammed, and are allied to the Shiahs of Persia; they number about 30,000, and are found W. of the Orontes and on the S. part of the Lebanon range. The Ansaries or Nossairians, inhabiting the mountains extending from the N. extremity of Cœle-Syria to the gorge of the Orontes at Antioch, and numbering about 30,000, keep their religious views a secret. The Ismaëlians, occupying the mountains W. of Hamah, are few, and were originally Shiahs; they are the descendants of the people known in the time of the crusades as Assassins. The fourth sect is the Druses, in the Lebanon and Anti-Libanus, numbering about 70,000, and the most fanatical of all. The largest of the nominally Christian sects is that of the Maronites, who are found chiefly in the Lebanon, though they have small communities in all the principal towns from Aleppo to Nazareth. Their number in 1874 was about 140,000. (See ANSARIES, ASSASSINS, DRUSES, and MARONITES.) The orthodox Greeks (Greeks in religion, but not generally in blood), numbering about 150,000, are scattered throughout the cities and more level portions of Syria, and engage in agriculture and trade; they have their worship in their own language. There are dissenters also from the Greek church, the Syrians or Jacobites, a mere handful, dwelling mostly N. and N. E. of Damascus. The Greek Catholic and Syrian Catholic churches acknowledge the pope, though in some particulars they approach more nearly to the Greek than the Roman church; they are about 50,000 in all, and embrace a large number of the more wealthy Christians in Syria. The Armenians are 50,000 or 60,000 in number. There are about 25,000 Jews in Syria; those in Palestine are immigrants from foreign countries, while those of Aleppo and Damascus are descendants of Jewish families who have resided there for many centuries. There are Mohammedan schools in the cities, and the Christian sects also maintain some schools. The children of the wealthy are frequently sent to France or England for education, but the great mass of the people are very illiterate. Of late years, however, great improvements have been made in education by means of schools established by Greeks, Catholics, and especially by Protestant missionaries. —The central part of Syria is designated in the Hebrew Scriptures as Aram Dammesek, or the Aram of which Damascus was the capital. The empire of the kings of Damascus gradually extended eastward over a part of the plain of Mesopotamia and westward to the mouth of the Orontes. It was finally overthrown by the Assyrians under Tiglath-pileser, about 740 B. C. From the head waters of the Orontes southward, all of Palestine W. of the Jordan, and probably Gilead and the Hauran E. of it, were peopled by the Canaanites. The Phœnicians settled mainly along the coast of the Mediterranean, and became the earliest commercial nation of the world. Sidon, their first metropolis, is said by tradition to have been founded by Sidon, the oldest son of Ham; and colonies from it went forth to Tyre and Arvad (Aradus), and thence to all portions of the Mediterranean and beyond. Phœnicia attained its greatest power about 1050 B. C., and it enjoyed uninterrupted prosperity for full 300 years, but was at last conquered by the Assyrians, and subsequently by the Babylonians and Persians. The southern parts of western and portions of eastern Palestine were inhabited by a tall race, the Anakim and Rephaim, traces of whose cities yet remain in the Hauran. The S. W. coast was occupied by the Philistines, and the region adjoining the Dead sea to the east by the Semitic Ammonites and Moabites. (See PALESTINE.) The equally Semitic Israelites emigrated from Egypt to Palestine about 1500, or according to some authorities about 1300 B. C., and thenceforward for about 1,500 years exerted a powerful influence in its history. (See HEBREWS.) The theocracy under which they existed for several centuries was terminated by the election of Saul as king early in the 11th century B. C., and the kingdom was divided (about 975) in the reign of Rehoboam, the grandson of his successor David. The ten tribes, or Israel as they were distinctively termed, were conquered and carried into captivity by the Assyrians in 721, and their place was supplied by colonists from Babylonia, Hamath, and elsewhere, who became the Samaritans of a subsequent era, and a few families of whom still exist on their ancient site. The kingdom of Judah fell before Nebuchadnezzar 133 years later, but after a 70 years' captivity the people were restored to their own land, and the second temple was built. Syria from this period, until Grecian power became paramount there, was governed by a Persian satrap resident at Damascus. The battle of Issus, in 333, led to the subjection of Syria proper, Phœnicia, and Palestine to Alexander the Great. On his death, and after a long struggle of succession on the partition of his empire, the Ptolemies in Egypt received Palestine and Cœle-Syria, and Seleucus Nicator northern Syria. He founded Antioch, near the mouth of the Orontes, and made it his capital; and for several centuries it was the greatest of oriental cities. The kingdom of Syria continued flourishing under the Seleucidæ till the beginning of the 2d century B. C. Antiochus the Great wrested Palestine and Cœle-Syria from Egypt. The

revolt of the Jews under the Asmonean family against Antiochus Epiphanes, after a struggle of 25 years, ended in their independence (142). (See Antiochus, Demetrius Soter, Hebrews, and Seleucus.) About 63 B. C. Syria became a Roman province, and subsequently was divided into several provinces; the Herodian family ruled over Judea and some adjoining districts, while northern Syria and the coast were under Roman proconsuls. After the destruction of Jerusalem by Titus (A. D. 70), the whole of Syria, including Judea, was ruled by a Roman prefect, and Antioch was the capital. It continued under the Roman and Byzantine empire till its conquest by Chosroes II. in the beginning of the 7th century, followed by that of the Mohammedans in 632–'8. In 654 Damascus again became the capital of Syria, and in 661 of the great Mohammedan empire. The capital was removed to Cufah in 750, and afterward to Bagdad, and Syria thenceforth became only a province of the empire of the caliphs. About the middle of the 10th century the rival Mohammedan dynasty of the Fatimites in Egypt conquered it, and in the latter part of the 11th the Seljuk Turks made it a part of their empire. The cruelties perpetrated by these fanatics on Christian pilgrims visiting the Holy Land led to the crusades. Jerusalem was taken by assault (1099), and the whole of Syria except Damascus and a part of Mesopotamia conquered by the Christian princes, and divided into principalities. Godfrey was chosen ruler of Jerusalem, Bohemond reigned at Antioch, Baldwin at Edessa, and the count of Toulouse at Tripoli. Their rule was of short duration; after repeated attacks by Noureddin and his successors, it was overthrown by Saladin in 1187. The crusades which followed resulted only in their regaining a few points, in the temporary acquisition of Jerusalem by treaty in 1229, and the final occupation of the whole country by the Mamelukes in 1291. (See Egypt.) For a long period the country was the prey of the two contending Tartar powers, Tamerlane and his successors and the Mameluke sovereigns of Egypt. In 1517 it was conquered by Sultan Selim I., and from that time to our own it has formed a part of the Ottoman empire. In 1832 Ibrahim Pasha conquered Syria for his father Mehemet Ali, pasha of Egypt; but in 1841, after the armed intervention of England and her allies, it was restored to the sultan. In the summer of 1860 an insurrection occurred on the part of the Mohammedans at Damascus, in which many Christians were slain, the Dutch consul killed, and the American consul wounded. At the same time sanguinary disturbances, such as had frequently occurred before, broke out in Mt. Lebanon, between the Druses and Maronites, and a predatory conflict of several months' duration followed, in which nearly 150 villages were destroyed. France and England finally interfered, the outbreak was suppressed, and the prime movers were brought to punishment, but not until more than 15,000 men had been killed, and tens of thousands of people were homeless and destitute, and compelled to take refuge in the cities of the coast.

**SYRIAC LANGUAGE AND LITERATURE.** The Syriac language belongs to the northern branch of the Semitic family. (See Semitic Race and Languages.) It is an Aramaic dialect, which rose to a literary language under the name of Syriac in the Christian schools of northern Mesopotamia. In writing it various forms of character are used, all of them of kindred origin, and coming from the same source whence are derived the other Semitic alphabets. The oldest character is the Palmyrene, represented by sundry inscriptions dating from the time of Christ. Next in age is the Estranghelo alphabet, commonly employed by the Syrians till the 8th or 9th century. The common

| Syriac names of characters. | Estranghelo of MSS. | Modern Syriac type (initial forms). | Modern Arabic type (independent forms). | Arabic names of characters. | Approximate sounds. |
|---|---|---|---|---|---|
| Olaph... | ܐ | ܐ | ا | Elif... | Spiritus lenis. |
| Beth.... | ܒ | ܒ | ب | Be.... | B |
| Gomal... | ܓ | ܓ | ج | Jim... | G |
| Dolath... | ܕ | ܕ | د | Dal... | D |
| He...... | ܗ | ܗ | ه | He.... | H |
| Vau..... | ܘ | ܘ | و | Waw.. | W or V |
| Zain.... | ܙ | ܙ | ز | Ze.... | Z |
| Cheth... | ܚ | ܚ | ح | Kha.. | Kh |
| Teth.... | ܛ | ܛ | ط | Tha... | Th |
| Yud..... | ܝ | ܝ | ي | Ye.... | Y |
| Koph.... | ܟ | ܟ | ك | Qef.... | K |
| Lomad.. | ܠ | ܠ | ل | Lam.. | L |
| Mim.... | ܡ | ܡ | م | Mim.. | M |
| Nun..... | ܢ | ܢ | ن | Nun.. | N |
| Semkath. | ܣ | ܣ | س | Sin... | S |
| Ee...... | ܥ | ܥ | ع | Ain.... | Indefinite. |
| Pe...... | ܦ | ܦ | ف | Phe... | Ph |
| Tsode... | ܨ | ܨ | ص | Dhad.. | Ts |
| Kuph... | ܩ | ܩ | ق | Kaf... | K |
| Rish.... | ܪ | ܪ | ر | Re.... | R |
| Shin.... | ܫ | ܫ | ش | Shin.. | Sh |
| Thau.... | ܬ | ܬ | ت | Te.... | T |

modern Syriac alphabet is an adaptation of the Estranghelo to an easier and more rapid style of writing; it began to come into use in the 5th and 6th centuries, and by degrees crowded out its predecessor, which was at last employed only for headings and similar purposes. The Estranghelo is also the parent of the Cufic, from which the modern forms of the Arabic are derived. Finally, we have the Nestorian character, still in common use with modern Nestorian Christians; it is heavier and squarer than the last named, and less altered from their common mother, the Estranghelo. All the Syriac alphabets contain the same 22 characters with the Phœnician and the Hebrew. The Syriac contains many Greek and Latin words, chiefly nouns; it has also partly filled out the scanty structure of the Semitic verb with forms of periphrastic origin. Thus, besides the usual perfect and imperfect (or preterite and future), each of which is capable of standing for time past, present, or future, it has a distinctive present, formed by a participle and following pronoun; an imperfect, formed of a participle and the verb to be; a pluperfect, formed of the perfect (or preterite) and the verb to be; and even a future, with the adjective ready, about to. Of the Semitic conjugations, the Syriac has but three, each with its passive; the second and third are hardly distinguished in meaning, both expressing intensive or causative action. The dual number has entirely disappeared. The ancient Syriac was a vernacular dialect during the first centuries after Christ; after being raised to the rank of a cultivated literary language, it maintained itself as such, unaltered, throughout the whole period of growth of the Syriac literature; and it is still the sacred language of the scattered bodies of Christians in Asia representing the ancient Syriac church. It is no longer properly understood, however, even by the best instructed among them. The vernacular dialect of the once powerful and active sect of Nestorians has been lately, by the efforts of the American missionaries at Urumiah, raised to the rank of a printed language, with a Christian literature, school and scientific books, periodicals, &c. (See NESTORIANS, and PERKINS, JUSTIN.)—The Syriac literature is Christian, composed under Greek influence and after Greek models; and besides the important part it has played as the intermediary between Greek and Moslem science and philosophy, it is a source of valuable historical information. The oldest Syriac work still existing is the translation of nearly the whole Bible, of unknown authorship, commonly called the Peshito; it is supposed to have been made not later than about A. D. 200. The earliest authors whose names, with fragments of their works, have come down to us, are a few years older; they are Bardesanes and his son Harmonius. Besides philosophical works, they composed the first hymns in the language, and fixed its poetic style, giving it a properly metrical form, dependent on accent and number of syllables, with occasional rhyme; it was the first time that any Semitic dialect had been subjected to such rules. But the most prominent early Syriac author is St. Ephraem, or Ephraem Syrus, of the middle of the 4th century; with him begins the full career of the Syriac literature, which continued uninterrupted until the 9th century. A great part of this literature has been lost, and what remains has as yet been but partially worked up and made accessible. It may be said to have done its principal work in the 8th and 9th centuries, in introducing classical learning to the knowledge of the Arabs. The grammatical study and culture of the Syriac began after the founding of the famous school of Edessa, long a chief centre of oriental learning, in the 5th century. The works of previous laborers in this field were effaced by those of Jacob of Edessa, of the 7th century, whose authority gave the classical and sacred dialect its final form. From his time the series of native grammarians and lexicographers is almost unbroken; of most note among the former are Elias of Nisibis (11th century), John Bar-Zugbi (beginning of the 13th century), and Bar-Hebræus, known also as an Arabic author by the name of Abulfaraj (13th century); of the latter the most important are Bar-Ali and Bar-Bahlul, of the 9th and 10th centuries. Bar-Hebræus, who is distinguished by both his Syriac and Arabic works, and in various departments of knowledge, is the last great name in Syriac literary history. The study of Syriac was introduced into Europe in the 15th century, and the names of Ambrosius, Widmanstad, the two Ecchellenses, and Assemani are prominent among its cultivators. The only comprehensive dictionary is that contained in Castell's polyglot lexicon, and published separately by Michaelis (Göttingen, 1788). Of the Latin grammar of Hoffmann (Halle, 1827), an English abridged translation has been published by Cowper (London, 1858); it has also been worked over and much extended and altered by Merx (1867). The German one of Uhlemann (Berlin, 2d ed., 1857) includes also a chrestomathy and glossary; this, too, has been reproduced in English in this country by E. Hutchinson (2d ed., New York, 1875). Among the other chrestomathies published, the most useful are those of Rödiger (Halle, 1838) and Kirsch, edited with a glossary by Bernstein (Leipsic, 1832). A complete lexicon was begun by Bernstein, but interrupted by his death; his collections and Quatremère's have since passed into the hands of Dean R. Payne Smith, who is now (1876) publishing a very full and learned dictionary. Besides Dean Smith, Cowper and Cureton are the best English cultivators of the study, and the latter especially has done great service by the publication of extracts from the precious collection of MSS. some time since acquired for the British museum from the convent of St.

Maria Deipara in Egypt. A grammar of the dialect of Urumiah, by the Rev. D. T. Stoddard, was published in 1856 by the American oriental society. Nöldeke has produced a fuller and more learned one, founded on this and on the texts published by the missionaries, entitled *Grammatik der neusyrischen Sprache* (Leipsic, 1868). Dr. Adalbert Merx has published a *Neusyrisches Lesebuch: Texte im Dialekte von Urmia* (Breslau, 1874).

**SYRINGA.** See LILAC, and PHILADELPHUS.

**SYROS.** See SYRA.

**SYRTIS MAJOR** and **Syrtis Minor,** the ancient names of two large gulfs on the N. coast of Africa, now called respectively the gulf of Sidra and the gulf of Cabes or Gabes. These gulfs were dangerous on account of their shallowness, the number of quicksands, and the uncertainty of the tides. The Greater Syrtis, or gulf of Sidra, is on the N. coast of Tripoli, and extends from the promontory of Boreum (now Ras Teyonas) on the E. side to that of Cephalæ (Ras Kasr Hamet) on the W. The distance between the two promontories is about 270 m., and the greatest extension of the gulf inland is 110 m. The Lesser Syrtis, or gulf of Cabes, indents the E. coast of Tunis, between the island of Jerbah on the south and Caput Vadorum (Ras Kapudiah) on the north; its width is about 100 m., measuring from these points. The region between the two gulfs, formerly called Syrtica, is mostly a narrow sandy or marshy strip of land, now belonging to Tripoli. In ancient times it was peopled by the Lothophagi, Macæ, Psylli, Nasamones, and other Libyan tribes, besides Egyptians and Phœnicians on the coast. Cyrene and Carthage contended for it, the latter winning, it is said, through the self-sacrifice of two brothers, the Philæni.

**SZABADKA** (Ger. *Maria-Theresiopel*), a town of S. Hungary, in the county of Bács, 96 m. S. S. E. of Pesth; pop. in 1870, 56,323. Its inhabitants are mostly agriculturists, but there is also considerable trade in cattle, tobacco, and other products.

**SZABOLCS,** a N. E. county of Hungary, in the Trans-Tibiscan circle, the Theiss constituting the N. and part of the W. frontier; area, 2,304 sq. m.; pop. in 1870, 265,584, chiefly Magyars. It is a wide, sandy plain, with large marshes, especially in the north and west, but the soil is fertile. The chief products are cattle, grain, tobacco, and wine. Capital, Nagy-Kálló.

**SZALA.** See ZALA.

**SZALAY, László,** a Hungarian historian, born in Buda, April 18, 1813, died in Salzburg, July 17, 1864. He studied at the university of Pesth, was admitted to the bar in 1833, was a member of the diet of 1839-'40, and prepared with Deák and others the penal code adopted by the lower house. Having edited for some time the *Themis*, and subsequently the *Budapesti szemle* ("Buda-Pesth Review"), he succeeded Kossuth in July, 1844, as editor of the *Pesti hirlap* ("Pesth Journal"). In 1847-'52 he published *Statusférfiak könyve* ("The Book of Statesmen"), a collection of political biographies. In 1848 he was sent by the Batthyányi ministry as envoy to the provisional central government of Germany at Frankfort, whence he soon after retired to London, and subsequently resided in Switzerland, until allowed to return to Hungary about the beginning of 1861, where he became a prominent member of the diet at Pesth. His principal work is *Magyarország története* ("History of Hungary," 6 vols., Leipsic and Pesth, 1850-'63; German ed., 1866 *et seq.*).

**SZATMÁR,** or **Szathmár. I.** A N. E. county of Hungary, in the Trans-Tibiscan circle, bounded N. by the Theiss, and intersected by the Szamos; area, 2,260 sq. m.; pop. in 1870, 280,568, chiefly Magyars. The E. part is mountainous, and contains the gold and silver mines of Nagy-Bánya; the remainder is level and partly marshy. The climate is healthful and mild, and the soil fertile, producing corn, maize, hemp, flax, wine, and tobacco. Cattle, swine, sheep, and bees are raised in great numbers. **II.** A town, capital of the county, 65 m. E. N. E. of Debreczin; pop. in 1870, 18,353. It consists of two parts, Németi on the N. bank of the Szamos, and Szatmár on an island in the river. It is the seat of a Catholic bishop, and has a Catholic gymnasium, a lyceum, a seminary, and Greek and Protestant churches. A considerable trade is carried on in wine, linen, and woollen fabrics.

**SZÉCHENYI, István,** count, a Hungarian statesman, born in Vienna, Sept. 21, 1791, died by his own hand at Döbling, April 8, 1860. He was the son of Count Francis Széchenyi, the founder of the national museum at Pesth, served in the last campaigns of Austria against Napoleon, and in 1825 took his seat in the upper house of the Hungarian diet. He contributed the sum of $30,000 toward the foundation of the Hungarian national academy, and was its vice president; and as leader of the national party he carried through a grand series of public enterprises. To popularize his schemes of reform, he published *Hitel* ("Credit," Pesth, 1830), and *Világ* ("Light," 1832). Frightened by Kossuth's radical agitation, he wrote against him his *Kelet népe* ("People of the East," 1840), and combated him in the diet of 1847; but in 1848 he yielded to the current, and entered the Batthyányi-Kossuth cabinet as minister of public works. On the outbreak of the war he became insane, and was taken to an asylum at Döbling near Vienna, in which, though he recovered after some time, he spent the remainder of his life. In March, 1860, his abode and papers were searched by the Austrian police, and shortly after he shot himself.

**SZEGEDIN** (Hun. *Szeged*), a city of Hungary, capital of the county of Csongrád, on the right bank of the Theiss, opposite the mouth of the Maros, 55 m. W. of Arad and 96 m. S. E. of Pesth; pop. in 1870, 70,179, chiefly Magyars

and Slavs. It stands in a marshy plain, and is divided into the town proper and the upper and lower suburbs. The river is crossed by a bridge of boats, and the town is defended by an old fortress built by the Turks in the 16th century, which contains extensive barracks, a house of correction, and a church of its own. There are six Roman Catholic churches, a Catholic gymnasium, and a beautiful Greek church. Cloth, tobacco, soda, and soap are manufactured, and river boats are built. It is connected by rail with all parts of the country, and carries on an extensive trade. In the summer of 1849 it was the seat of the Hungarian diet till it was taken by the Austrians early in August.

**SZEKLERS.** See Transylvania.

**SZOLNOK. I. Middle,** a county formerly belonging to Transylvania, and now to Hungary, bounded S. E. by Transylvania; area, 855 sq. m.; pop. in 1870, 113,639, chiefly Wallachs. It is mountainous, and watered by tributaries of the Szamos. Capital, Szilágy-Somlyó. **II.** A town of Hungary, in the county of Heves, on the Theiss, 56 m. E. S. E. of Pesth; pop. in 1870, 15,847, chiefly Magyars. It is connected with Pesth, Arad, and Debreczin by rail, and has considerable trade and important fisheries.

# T

T, THE 20th letter and 16th consonant of the English and other alphabets derived from the Roman, the 19th of the Greek (*tau*), and the 9th of the Hebrew (*teth*). It is of the denti-lingual class, and represents the sound produced by a forcible emission of the breath after placing the tongue against the roof of the mouth near the roots of the teeth. This forcible emission of the breath is the principal distinction between the sounds of *t* and its sonorous counterpart *d*. In etymology it is interchangeable with *d*, and sometimes with *th*, *p*, *s*, and *l*. By itself it has but one sound; but combined with *h*, it forms a simple sound, hard or soft in quality, distinct from that of either component; as the *th* in *thigh*, which the Anglo-Saxons represented by ð, the Greeks by $\theta$ (*theta*), and the Hebrews by ת (*tav*); or as in *thy*, which the Anglo-Saxons represented by þ. This sound is wanting in all the other European languages except Spanish (*d*, *z*, and *c* before *e* or *i*), modern Greek ($\theta$ and $\delta$), Danish (*d* between vowels, very faint), and Welsh (*dd*). In French *t* is dropped in many words from the Latin where it is preceded and followed by a vowel; as in *père*, *mère*, *vie*, from *pater*, *mater*, *vita;* also from the termination of many words. In English, before *i* and another vowel, *t* has the sound of *sh*, as in *nation;* in French, of *s;* in German, of *tz.*—As a Greek numeral $\tau$ stood for 300, $\,_{,}\tau$ for 300,000. Among the Latins T represented 160, and with a dash above it ($\bar{T}$) 160,000. As an abbreviation it stands for *theologia*, as in S. T. D., *sacræ theologiæ doctor;* and in ancient writings, monuments, or coins, for Titus, Titius, Tullius, and sometimes *tribunus.* (See D.)

**TABASCO,** a S. E. state of Mexico, bounded N. by the gulf of Mexico, E. by Campeachy, S. by Guatemala and Chiapas, and W. by Vera Cruz; area, 12,716 sq. m.; pop. in 1871, 83,707, chiefly Indians. The coast is indented by several bays and lagoons, and there are islands toward its N. E. extremity, the most important of which are Laguna, Carmen, and Puerto Real. The surface is generally flat and in some places marshy, and there are several small lakes. The rivers, with the exception of the Usumasinta and Tabasco, are generally small, and they all overflow at certain seasons. The climate is hot and unhealthful; and between September and March gales render navigation dangerous even on the rivers. Oak, cedar, ironwood, and mahogany abound. Cacao, coffee, pepper, sugar cane, palmetto, tobacco, maize, and rice are cultivated; in some places indigo grows spontaneously; and wild bees afford large supplies of wax and honey. Capital, San Juan Bautista.

**TABERNACLE** (Lat. *tabernaculum*, tent; Heb. *ohel*), the sanctuary which the Israelites carried with them through the desert, and which, after the conquest of Canaan, was set up in various towns of Palestine until the time of Solomon, when it was replaced by the temple of Jerusalem. It was constructed, by order of Moses, by Bezaleel and Aholiab, and set up for the first time on the first day of the first month in the second year after leaving Egypt. Its framework consisted of 48 perpendicular gilded boards of acacia wood, which were kept together by golden rings and fixed into silver sockets. Over these boards four coverings were spread. The entrance, at the east end, was closed by means of a splendid curtain, supported by five columns. A curtain divided the interior into two rooms, the sanctuary and the holy of holies. In the sanctuary was placed, on the north, the table with the 12 loaves of shew bread (see Shew Bread); toward the south the golden candlestick; and in the middle the altar of incense. In the holy of holies stood the ark of the covenant. The tabernacle was surrounded by a kind of courtyard which was 100 cubits long and 50 cubits wide. The typical significance of the tabernacle has been, ever since the times of Philo and Josephus, a subject of investigation. The most important treatises on the subject in modern times are by Creuzer, *Symbolik des mosaischen Cultus* (2 vols., Heidelberg,

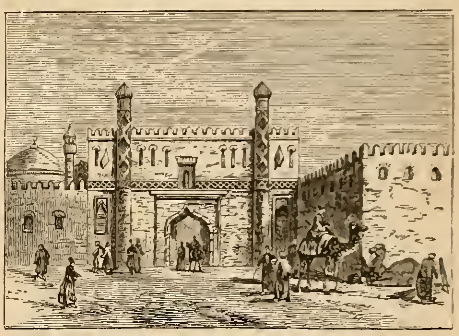
1837–'9), and Friedrich, *Symbolik der mosaischen Stiftshütte* (Leipsic, 1841).

**TABERNACLES, Feast of** (Heb. *'hag hassukoth*), one of the three great festivals of the Jews, observed after harvest, and beginning on the 15th day of the month Tisri. It commemorated God's protecting care over his people while they dwelt in the wilderness. It was also a harvest feast or thanksgiving. It continued eight (among the exiled Jews nine) days, the first and last (in exile the first two and last two) of which were the most important. To the ceremonies of the festival belongs the waving toward the four quarters of the world of fine fruits and leafy branches, with the singing of liturgical songs, commonly called, from the repetition of the words *hosia' na* (Oh save!), Hosanna. On the seventh day this was repeated, for the last time, with greater solemnity. During the first seven days the living in booths was obligatory, which is still partially observed by the Jews in most countries. Sacrifices took place in the temple, and in later times also a ceremony of "pouring water" on the sacrifice, and a great illumination of the outer court, with dances by torchlight.

**TABOR, Mount** (Gr. *'Αταβύριον*; now *Jebel et-Tur*), an insulated eminence in the plain of Esdraelon, about 6 m. S. E. of Nazareth, in Galilee, commonly regarded as the scene of the transfiguration of Christ. It is about 1,800 ft. high, composed entirely of limestone, and its sides are covered up to the summit with the valonia oak, wild pistachios, myrtles, and other shrubs. Its summit is a plateau about 600 yards in extent from N. to S. and 300 yards across. All around this plain are traces of an ancient wall, and below it on the S. E. side of the hill are the ruins of a fortification, a gateway of Saracenic architecture called "the gate of the wind," and a small vault where the Latin monks from Nazareth annually celebrate the transfiguration. Among the ruins of a church on the N. side of the mountain the Greeks observe the same festival. Tabor is several times mentioned in the Old Testament, and upon it Deborah and Barak assembled the warriors of Israel previous to the battle with Sisera. There was upon it a city of the Levites of the tribe of Zebulon, which was taken and fortified by Antiochus the Great, 218 B. C. In 55 B. C. a battle was fought near it between the Romans under the proconsul Gabinius and the Jews under Alexander the son of Aristobulus, in which 10,000 Jews were slain. Tabor is not named in the New Testament, and was first mentioned as the place of the transfiguration in the 4th century. At the foot of it the crusaders several times fought the Moslems, and Napoleon gained a victory over the Turks.

**TABORITES.** See HUSSITES.

**TABRIZ, Tebriz,** or **Tauris,** a walled city of Persia, capital of the province of Azerbijan, in lat. 38° 4′ N., lon. 46° 15′ E., near the river Aji; pop. about 120,000. It stands on a wide plain, 4,944 ft. above the sea, enclosed on all sides but the west by low mountains or hills. The vicinity is very fertile, and beautified by innumerable fruit gardens, celebrated for their peaches and apricots, and producing grapes from which is made a wine resembling Marsala. The wall of sun-dried bricks is about 3½ m. in circuit. The streets are narrow and tortuous, and the houses low and flat, but there is a large square, and the bazaars are numerous and spacious. The most remarkable buildings are the citadel, a lofty structure with massive brick walls; the Blue mosque, built in the 17th century by Abbas the Great, but now in ruins; and the villa of the heir apparent to the Persian throne, who resides here as governor of Azerbijan. Tabriz is one of the most important commercial cities in Persia. It is on the caravan route between the interior and Trebizond and Tiflis, and carries on a large foreign trade, also maintaining manufactories



City Gate, Tabriz.

of silk and cotton goods.—According to Persian tradition, Tabriz was founded by Zobeida, wife of Haroun al-Rashid; but the town existed in antiquity, and under the name of Gazaca was the capital of the Median province of Atropatene. At a later period it was the capital of Tiridates III., king of Armenia. It was visited by Marco Polo about 1293, and in 1320 there appear to have been Venetians settled there, and a Genoese factory in 1341. The present number of European inhabitants probably does not exceed 100. Tabriz has frequently been captured by the Turks, and it has often been damaged by earthquakes. The Anglo-Indian telegraph line passes through the city.

**TACHÉ, Alexandre,** a Canadian archbishop, born at Kamouraska, Lower Canada, in 1822. He graduated at the college of St. Hyacinthe, became an Oblate of the Immaculate Conception, and in 1843 asked to be sent to the Red River mission. He was ordained priest at St. Boniface, and devoted himself to the Indian tribes beyond the civilized regions of Canada, especially along the valley of the Saskatchewan. He was among the first to penetrate into the unexplored portions of the northwestern territory, and contributed toward the colonization and progress of Manitoba. He was consecrated

coadjutor to Bishop Provencher of St. Boniface, Nov. 23, 1851, and succeeded him, June 7, 1853. In September, 1871, he was made metropolitan. During the troubles attendant on the Riel insurrection in 1869–'70 he exerted his influence to prevent the effusion of blood; and after the surrender of Riel and the latter's election to the Dominion house of commons, the archbishop resisted successfully all attempts of the authorities to punish him as a traitor. He has established a college and theological seminary at St. Boniface, opposite Fort Garry, and, besides numerous interesting reports on the Indian missions printed in the "Annals of the Propagation of the Faith," has published *Vingt années de missions dans le nord-ouest de l'Amérique* (Montreal, 1866), and *Esquisse sur le nord-ouest de l'Amérique* (1869).

**TACITUS, Caius Cornelius**, a Roman historian, born probably about A. D. 55, died probably after the accession of the emperor Hadrian (117). He was early appointed to a public office under Vespasian, and married a daughter of Julius Agricola. He held a prætorship under Domitian, and was *consul suffectus* under Nerva. Nothing positive is known of his subsequent career. He was famous as an orator and a lawyer, and the rhetorical studies of his earlier years led him to compose his first work, the *Dialogus de Oratoribus*, which contrasts strongly with his later writings for diffuseness and negligence. His *Vita Julii Agricolæ* is the masterpiece of ancient biography, and specially valuable for the account it gives of the early condition and history of Britain. The *Germania* (*De Origine*, *Situ*, *Moribus ac Populis Germaniæ*) appeared soon after, both probably in 98. It is based on the works of Pliny and the most trustworthy sources obtainable at the time, and as such is of great importance to students of German antiquities. Numerous theories have been broached in regard to the author's purpose in writing it, but there is every reason for supposing that one of his main objects was to remind the Romans of the virtues of their former days, and to warn them of the dangers threatening them from the north. Its geographical and historical accuracy has often been attacked, and as often successfully vindicated, though he has frequently exaggerated or idealized the customs and morals of the German people. About the year 105 appeared the first portion of his history of Rome after the time of Augustus, embracing *Historiæ* of the years 69–96, or from the last days of Galba to the death of Domitian. Only the first four books and a part of the fifth, reaching to the year 70, are extant. Next appeared the *Annales*, a concise history of the events from 14 to 68. Its original title was *Ab Excessu D. Augusti Libri.* Of the original 16 books, only nine complete and parts of three others are extant. The portions relating to the last two years of Nero are wanting. Tacitus is commonly compared to Thucydides; but the latter has none of the psychological characteristics of the former. There is a greater resemblance between Tacitus and his forerunner Sallust. His style is remarkable for its vigor and conciseness. A melancholy and almost tragic earnestness pervades his pictures of imperial history. Numerous interpolations disfigure his writings, especially the last portion of the *Annales* and the *Historiæ*. The *editio princeps* of Tacitus, which is far from complete, was printed at Venice in 1469 by Vindelin de Spira; and of the numerous subsequent editions that of Ernesti (Leipsic, 1752), successively revised by Oberlin, Bekker, Walther, Ruperti, and others, and Halm's (Leipsic, 1874), are esteemed the best. The best translations are: in German, by Roth (Stuttgart, 1855–'7); in French, by Louandre (Paris, 1858) and Dureau de la Malle (1874); and in English, by Church and Brodribb (London, 1864). German literature abounds with hermeneutical treatises on Tacitus; Pfitzner's *Die Annalen des Tacitus kritisch beleuchtet* (Halle, 1869) is very thorough.

**TACITUS, Marcus Claudius**, a Roman emperor, born at Interamna (now Terni), Umbria, about A. D. 200, died at Tyana, in Cappadocia, in April, 276. Previous to the assassination of the emperor Aurelian in March, 275, he held various important civil offices, the last being that of consul in 273, and was well known for his love of letters, his great wealth, and his integrity. In September, 275, Tacitus was unanimously elected emperor by the senate. He instituted a few domestic reforms, and attempted to revive the authority of the senate, but died within little more than half a year from the commencement of his reign. According to one account, he was assassinated by his soldiers when on an expedition against the Goths in Asia Minor. He claimed descent from the historian Tacitus, whose works he ordered to be placed in all public libraries, and to be multiplied to the extent of ten copies a year at the public expense.

**TACKMAHACK, or Balsam Poplar.** See POPLAR.

**TACONIC SYSTEM, or Taghkanic.** See UNITED STATES (geological part).

**TADEMA, Lourenz Alma**, a Dutch painter, born at Drouryp, West Friesland, Jan. 8, 1836. He studied under Leys at Antwerp in 1861, and became known as a painter of classical subjects. His wife, the countess Pauline Dumoulin, died in 1869, and in 1870 he married an English woman and removed to London. His works include "Venantius Fortunatus and Radegond" (1862), "How they enjoyed themselves in Egypt 3,000 Years ago" (1863), "The Mummies" (1867), "The Siesta of Ancient Romans" (1868), "The Vintage Celebration at Rome" (1870), "The Last Plague of Egypt" (1872), and "The Picture Gallery" (1874).

**TADMOR.** See PALMYRA.

**TADOLINI, Adamo**, an Italian sculptor, born in Bologna in 1789. He studied in the academy of Bologna, and settled in Rome. In 1812 he received for his "Dying Ajax" the grand

prize instituted by Canova, under whose direction he executed from 1813 to 1820 many works, including a statue of Washington. His subsequent productions comprise "Venus and Amor," "The Abduction of Ganymede," "Francis de Sales," "A Bacchante," and "The Archangel St. Michael," a colossal marble group for which an American is said to have paid $40,000 (1869).

**TADPOLE.** See FROG.

**TAEL,** a Chinese measure of weight, equal to 1⅓ oz. avoirdupois. The Chinese government does not coin gold or silver. All payments are made in bullion or foreign coins, by weight; hence the tael (Chin. *liang*) has become a money of account, and 720 taels are received at Hong Kong and Shanghai as equivalent to 1,000 Mexican dollars. Taking the value of the Mexican dollar as fixed by the secretary of the treasury of the United States, Jan. 1, 1875, the tael would be equivalent to 1·386 United States dollar. The name is sometimes applied to the money of Japan, Siam, and Sumatra, and is probably of Malay origin.

**TÆNARUM.** See CAPE MATAPAN.

**TAFILET,** or **Tafilelt,** a division of Morocco, consisting of the oasis of the same name, lying S. E. of the Atlas mountains, between lat. 30° 45′ and 31° 10′ N. and lon. 3° 3′ and 3° 25′ W.; pop. estimated at 100,000. The oasis of Tissimi lies N. of it, and that of Sahra N. E. Tafilet is a fertile plain watered by two rivers, both of which are lost in the sands of the desert. Rain seldom falls. Wheat and barley are cultivated on the banks of the rivers, but dates are the chief product. Large herds of sheep and goats are kept, and stuffs and carpets are manufactured. There are mines of lead and antimony. The oasis is divided into five districts, Sfalet, Rhorfa, Iffli, Shiffa, and Tannajiut. The most important town is Abuam, about 240 m. E. S. E. of Morocco, but the official centre is Rissani, a few miles N. E. of Abuam. The inhabitants are mostly Shelloohs. A considerable trade is carried on with other parts of Morocco and with Algeria.—Tafilet, which is mentioned by the earliest Arab chroniclers, is probably identical with the kingdom of which Sigilmessa, founded A. D. 759, was the capital. In 1648 a king of Tafilet founded the dynasty which still rules Morocco.

**TAGANROG,** a city of southern Russia, in the government of Yekaterinoslav, on a promontory formed by the sea of Azov, 18 m. from the mouth of the Don and 27 m. N. W. of Azov; pop. in 1867, 25,027, including many Armenians and Greeks. It is strongly fortified, and despite the shallowness of the harbor it is the principal port of the sea of Azov. The exports in 1873, chiefly wheat, amounted to 28,797,839 rubles, and the imports to 8,048,663. The town has four large squares. The principal buildings are the cathedral, the admiralty, the marine hospital, the quarantine, the exchange, the theatre, and the palace near the Greek monastery of Jerusalem, built by Alexander I., who died and has a monument here. It was originally founded in 1696, but the present city dates from 1768. Taganrog was much damaged in 1855 by the bombardment from French and English gunboats, as well as the neighboring seaport Mariupol (founded in 1779 by Greeks; pop. about 6,000), which is under the municipal authority of Taganrog.

**TAGLIACOZZI.** See TALIACOTIUS.

**TAGLIONI. I. Filippo,** an Italian ballet master, born in Milan in 1777, died near the lake of Como, Feb. 11, 1871. He was successively connected with the theatres at Stockholm, Cassel, and Warsaw till 1853, when he returned to Italy. The most celebrated of his numerous ballets is the "Sylphide." He married a daughter of the Swedish tragedian Karsten. **II. Maria,** a dancer, daughter of the preceding, born in Stockholm about 1804. In 1822 she first appeared at Vienna, in 1827 at Paris, and in 1832 at Berlin. In the last year she married Count Gilbert de Voisin. She retired in 1847, and has since lived at her villa on the lake of Como, or in one of her palaces at Venice. She gained her greatest triumphs in *La bayadère*, *La Sylphide*, and *La fille du Danube*. **III. Paul,** brother of the preceding, born in Vienna about 1808. After performing with his sister in various theatres, he married the dancer Amalia Galster, with whom he made tours in Europe and the United States. His career as a dancer ended in 1847, when he became ballet master at the royal theatre in Berlin. He has since produced *Sardanapal*, *Undine*, and other celebrated ballets.—His daughter MARIA, born in Berlin in 1834, excelled as a dancer, but in 1866 retired from the stage, on her marriage with Prince Joseph Windischgrätz.

**TAGUS** (Span. *Tajo;* Port. *Tejo*), a river of Spain and Portugal, the longest in the peninsula, and dividing it into two nearly equal parts. It rises in the Sierra de Cuenca, in the province of Teruel near the border of Guadalajara, and flows N. W. for about 35 m.; then nearly W. 20 m., receiving the waters of the Molina; then S. W. a little more than 70 m., the Guadiela and other streams augmenting it; then nearly W. till it becomes for about 20 m. the boundary of Portugal, its principal affluents being the Jarama, Cedron, Guadarrama, Alberche, and Alagon. Entering Portugal, it inclines more and more to the southwest, receiving below Abrantes the Zezere, and from that point is navigable for vessels of 150 tons. In the lower part of its course are numerous islands, and for about 20 m. it spreads out into a table-like basin, 8 m. or more in width; but as it approaches Lisbon the hills on either side close up the valley, and at its mouth it is not over a mile wide. The banks of the Tagus are generally rugged and precipitous, and the adjacent plains are dry and barren. Lisbon, Santarem, and Abrantes in Portugal, and Talavera de la Reyna, Toledo, and Aranjuez in Spain, are on its banks. Its length is about 540 m.

**TAHITI.** See SOCIETY ISLANDS.

**TAHLEQUAH,** the capital of the Cherokee nation, Indian territory, in the valley of Illinois river, a tributary of the Arkansas, 170 m. W. N. W. of Little Rock, Ark., and 15 m. E. of the Missouri, Kansas, and Texas railroad; pop. about 300. The capitol, of brick, cost $20,000. There are two schools and a weekly newspaper (Cherokee and English).

**TAILLANDIER, René Gaspard Ernest.** See p. 905.

**TAINE, Hippolyte Adolphe,** a French author, born in Vouziers, April 21, 1828. He was educated at the Bourbon college, was connected with the normal school of Paris for five years, and since 1864 has been professor of the history and æsthetics of art in the school of fine arts. His *Essai sur Tite Live* (1854) received a prize from the French academy. His other works are: *Voyage aux eaux des Pyrénées* (1855); *Les philosophes français du XIX^e siècle* (1856); *Essais de critique et d'histoire* (1857; second series, 1865); *La Fontaine et ses fables* (1860); *Histoire de la littérature anglaise* (4 vols., 1864); *Idéalisme anglais: étude sur Carlyle* (1864); *Le positivisme anglais: étude sur Stuart Mill* (1864); *Philosophie de l'art* (1865); *Philosophie de l'art en Italie* (1866); *Voyage en Italie* (2 vols., 1866); *Notes sur Paris* (1867); *L'idéal dans l'art* (1867); *Philosophie de l'art dans les Pays-Bas* (1868); *De l'intelligence* (2 vols., 1869); *Philosophie de l'art en Grèce* (1870); and *Notes sur l'Angleterre* (1874). Most of his works have been translated into English by Durand, Van Laun, Haye, Rae, Fiske, and Stevens. In 1875 Taine began the publication of *Les origines de la France contemporaine*, with a volume on the *Ancien régime*, which is to be followed by one on the revolution.

**TAIPING.** See CHINA, vol. iv., p. 463.

**TAIT, Archibald Campbell,** an English clergyman, born in Edinburgh, Dec. 22, 1811. He was educated at the university of Edinburgh and at Balliol college, Oxford, and was afterward public examiner of the university. He was prominent in the opposition to the tractarians. In 1842 he succeeded Dr. Arnold as head master of Rugby school, where he remained eight years. In 1850 he was made dean of Carlisle, in 1856 bishop of London, and in 1868 archbishop of Canterbury. He has published "The Dangers and Safeguards of Modern Theology" (London, 1861), "The Word of God and the Ground of Faith" (1863), and two volumes of sermons.

**TAIT, Peter Guthrie,** a British mathematician, born about 1825. He graduated at Cambridge, was fellow of St. Peter's college, became professor of mathematics in Queen's college, Belfast, and in 1862 was elected professor of natural philosophy in the university of Edinburgh. He has published "A Treatise on Dynamics of a Particle," in conjunction with William J. Steele (8vo, Cambridge, 1856); "Value of the Edinburgh Degree, an Address" (8vo, Edinburgh, 1866); "Elementary Treatise on Quaternions" (8vo, Cambridge, 1867); and "Thermodynamics" (8vo, Edinburgh, 1868). He has also, in conjunction with Sir William Thomson, published an "Elementary Treatise on Natural Philosophy" (8vo, London, vol. i., 1867).

**TALAVERA DE LA REYNA** (anc. *Talabriga*), a town of Spain, in the province of Toledo, on the Tagus, 64 m. S. W. of Madrid; pop. about 9,000. It is a place of great antiquity, and was the scene of many conflicts between the Moors and Christians. On July 27 and 28, 1809, a battle was fought in the immediate vicinity, between the French, under Victor, Jourdan, and Sebastiani, and the British, under Sir Arthur Wellesley. In the decisive contest of the 28th, 30,000 French were driven back by 16,000 British troops.

**TALBOT. I.** An E. county of Maryland, bounded W. by Chesapeake bay, and S. and E. by the Choptank river; area, 250 sq. m.; pop. in 1870, 16,137, of whom 6,666 were colored. The surface is generally level, and the soil highly fertile. The Maryland and Delaware railroad terminates at the county seat. The chief productions in 1870 were 302,078 bushels of wheat, 515,122 of Indian corn, 38,825 of oats, 41,770 of Irish and 10,725 of sweet potatoes, 29,695 lbs. of wool, 99,008 of butter, and 990 tons of hay. There were 3,298 horses, 3,309 milch cows, 3,678 other cattle, 6,044 sheep, and 9,411 swine; 3 manufactories of carriages and wagons, 5 of clothing, 3 ship yards, and 7 saw mills. Capital, Easton. **II.** A W. county of Georgia, bounded N. E. by Flint river and drained by several large creeks; area, 524 sq. m.; pop. in 1870, 11,913, of whom 7,157 were colored. The surface is hilly and the soil good. It is crossed in the southeast by the Southwestern railroad. The chief productions in 1870 were 18,372 bushels of wheat, 200,645 of Indian corn, 12,940 of oats, 27,786 of sweet potatoes, and 7,020 tons of hay. There were 631 horses, 1,325 mules and asses, 2,021 milch cows, 3,435 other cattle, 1,093 sheep, and 9,308 swine. Capital, Talbotton.

**TALBOT, William Henry Fox,** an English author, born at Chippenham, Wiltshire, Feb. 11, 1800. He was educated at Harrow and Cambridge, represented the liberal interest of Chippenham in the first reform parliament, 1832–'4, and became high sheriff of Wiltshire in 1840. In 1833 he began the experiments which in 1840 resulted in the discovery which laid the foundation for the photographic art. (See PHOTOGRAPHY.) For this discovery he received in 1842 the medal of the royal society; and although he patented his process, he left it open to the public. Of late years he has devoted himself to deciphering cuneiform inscriptions. He has published "Legendary Tales in Verse and Prose" (London, 1830); "Hermes, or Classical and Antiquarian Researches" (2 parts, 1838–'9); "Antiquity of the Book of Genesis" (1839); "The Pencil of Nature," in which he details his experiments and discoveries in photography (6 parts, 1844–'6); and "English Etymologies" (1846).

**TALC**, a silicious mineral occurring in two forms, crystalline and massive. The massive variety was formerly called steatite (soapstone), and was regarded as a distinct species; but it has the same chemical composition as crystalline talc, viz., $4MgO,5SiO_2\frac{3}{2}H_2O$, or silica 62·14, magnesia 32·92, and water 4·94 per cent., being a hydrous silicate of magnesia. Talc is commonly in the form of lamellar crystals, which cleave perfectly in one direction, but are usually too incompletely developed to allow of an exact determination of their crystalline system; but hexagonal prisms and plates are occasionally found. They are optically biaxial. The lamellæ are very flexible but not elastic, and are unctuous to the touch. Talc is very soft, being only 1 on the scale of 10; sp. gr. from 2·6 to 2·8; lustre pearly; color apple-green to white, also greenish gray to dark green, subtranslucent. Talc, either in a foliated or lamellar form, or massive as steatite, is common, forming extensive beds in some localities. It is often associated with serpentine, talcose, or chloritic schist. Steatite or soapstone is known in different localities as potstone (*Topfstein*), *lapis ollaris*, rensselaerite, and French chalk (*craie de Briançon*). There are extensive quarries at Grafton, Athens, Westfield, and Marlborough, Vt.; at Francestown, Pelham, and Keene, N. H.; at Middlefield, Chester, and other places in Massachusetts; in Maryland near Baltimore, in Virginia near Washington and in Loudon co., and in Guilford co., N. C., and numerous other places, in metamorphic rocks. It is used for making stoves, ovens, and hearths; for sizing-rollers in cotton factories, on account of its not being affected by acids; and sometimes as a lubricant for journals. It is also used for slate pencils and crayons, and for the stoppers of chemical vessels. The American aborigines use it for culinary articles, and the Chinese for the carving of idols.

**TALENT** (Gr. *τάλαντον*; Lat. *talentum*), a term originally applied by the ancient Greeks to a balance for weighing, afterward to the substance weighed, and finally to the weight itself. In the system of weights in use the talent was the highest denomination, and was equivalent to 60 minas, each of which was equal to 100 drachmas, and each of these to 6 oboli. The values of these weights remained constant in relation to each other, while that of the units of the measure varied in different times and in different places. The system of money being based upon the weight of silver, the names of the weights employed came to be used as money values, in the same way as the English pound originally represented a pound weight of silver. No coins however are known to have been made larger than the tetradrachma, and the mina and talent were moneys of account only. The determination of the weights of the different talents in terms of our modern standards is a subject involved in great difficulty, and there is a marked disagreement among scholars. The oldest talent was the Babylonian, which was carried into the Phœnician and Grecian countries, and may with great probability be assumed as identical with the oldest Greek talent, called the Æginetan. The Hebrew talent differed but little if at all from this. The Euboic talent, also probably derived from the East, was in use in Attica previous to the time of Solon, and is often called the old Attic; it continued in use after the time of Solon, and hence was also called the commercial talent. Solon, in order to relieve the debtor class, reduced the talent so far as money was concerned, and the talent established by him, called the new Attic or Attic silver talent, is the one always meant in the classical authors when the context does not indicate a different one. The ratio of these talents to each other was as follows, in whole numbers: 15 Æginetan talents were equal to 18 Euboic or commercial talents, and to 25 Solonian or Attic silver talents. Their weights compared with our avoirdupois weight were probably as follows: the Æginetan equalled 95 lbs.; the Euboic, 79 lbs. 2 oz. 291·63⅓ gr.; the Attic silver talent, 57 lbs. The value of these talents in pure silver, taking the American trade dollar, containing 378 gr. of pure silver, as the standard, would be as follows: the Æginetan talent equals $1,759 26; the Euboic, $1,466 05; the Attic silver talent, $1,055 56. The coins in actual use fell below this standard both in weight and in purity, and varied in different ages. For approximate calculation the coin value of the above named talents may be assumed as equal to $1,700, $1,400, and $1,000 respectively. Various other talents are named by the ancient writers, the comparative values of which have been treated in the works of Böckh and of Hussey. The gold talent of the Greeks, or the Sicilian talent, the one always meant in Homer, contained about ¾ oz. and 71 gr. avoirdupois of gold.

**TALFOURD, Sir Thomas Noon**, an English author, born at Doxey, a suburb of Stafford, Jan. 26, 1795, died in Stafford, March 13, 1854. He was called to the bar in London in 1821, and in 1833 was made serjeant at law. From 1835 to 1841 he was member of parliament for Reading, and again from 1847 to 1849, when he was made a judge of the court of common pleas. In parliament he was distinguished by his efforts in behalf of the rights of authors, for whose benefit he introduced in 1837 the copyright act which, somewhat modified, was passed in 1842. His tragedy of "Ion" (1835) was acted with great success under the direction of Mr. Macready, and was followed by "The Athenian Captive" (1838), "Glencoe" (1840), and "The Castilian" (1854). The last was not acted, and "The Athenian Captive" and "Glencoe" were but moderately successful on the stage. His other works include memoirs and correspondence of his friend Charles Lamb (1837 and 1838, subsequently published as one work), and "Final Memoirs" (1848).

**TALIACOTIUS, Gasparo** (TAGLIACOZI, or TAGLIACOZZIO), an Italian surgeon, born about 1546, died in Bologna, where he was professor of anatomy and surgery, in 1599. He attained high renown for his medical lectures, but is now mainly remembered for what has been named from him the Taliacotian operation for the restoration of lost noses, ears, &c. Though this operation was not original with him, yet he carried it to greater perfection and was more successful than any of his predecessors. His process was fully detailed in his work *De Curtorum Chirurgia per Insitionem Libri II.* (2 vols. fol., Venice, 1597; new ed., Berlin, 1831). (See AUTOPLASTY.)

**TALIAFERRO,** a N. E. county of Georgia, drained by affluents of the Ogeechee and Little rivers; area, 185 sq. m.; pop. in 1870, 4,796, of whom 2,987 were colored. The surface is hilly and the soil generally fertile. Granite, gneiss, sulphuret of iron, and magnetic ore are found. It is intersected by the Georgia railroad. The chief productions in 1870 were 9,418 bushels of wheat, 78,815 of Indian corn, and 3,024 bales of cotton. There were 543 horses, 2,120 cattle, 1,220 sheep, and 3,714 swine. Capital, Crawfordsville.

**TALIPOT TREE.** See PALM, vol. xiii., p. 20.

**TALLADEGA,** a N. E. county of Alabama, bounded W. by the Coosa river and drained by Chockolocko creek and other streams; area, about 700 sq. m.; pop. in 1870, 18,064, of whom 9,595 were colored. The surface is moderately hilly and the soil fertile. The Selma, Rome, and Dalton railroad traverses it. The chief productions in 1870 were 69,321 bushels of wheat, 284,783 of Indian corn, 42,821 of oats, 14,469 of sweet potatoes, 5,697 bales of cotton, 5,784 lbs. of wool, and 53,167 of butter. There were 922 horses, 1,786 mules and asses, 5,333 cattle, 2,355 sheep, and 6,947 swine; 4 tanneries, 3 currying establishments, and 2 saw mills. Capital, Talladega.

**TALLADEGA,** a city and the capital of Talladega co., Alabama, on the Selma, Rome, and Dalton railroad, 78 m. N. by E. of Montgomery; pop. in 1870, 1,933, of whom 1,013 were colored; in 1875, about 3,000. It is the seat of the state institution for the deaf and dumb and the blind, of a Presbyterian female seminary, and of Talladega college. The college was incorporated in 1869, and is sustained by the American missionary society. It admits both sexes and colors, and has in operation preparatory, theological, and normal courses, and grammar, intermediate, and primary departments. In 1874–'5 it had 13 instructors and 247 students. Talladega has two weekly newspapers and six churches, and trade in cotton, wheat, &c. On its site, Nov. 9, 1813, Gen. Jackson gained a victory over the Creeks.

**TALLAHASSEE,** a city and the capital of Florida, county seat of Leon co., on the Jacksonville, Pensacola, and Mobile railroad, at the junction of a branch to St. Mark's, 155 m. W. of Jacksonville and 21 m. N. of the gulf of Mexico; lat. 30° 25′ N., lon. 84° 18′ W.; pop. in 1870, 2,023, of whom 820 were white and 1,203 colored; in 1875, about 2,500; including suburbs, 4,000. It is beautifully situated on high ground, and is regularly laid out in a plot a mile square, with broad streets and several public squares, shaded with evergreens and oaks. The abundance and variety of flowers and shrubs give it the appearance of a garden. The business portion is of brick. The public buildings are the capitol (commenced in 1826), a large three-story brick edifice, with pillared entrances opening east and west; the court house, a substantial two-story brick structure; and the West Florida seminary, a large two-story brick building, on a hill commanding a view of the entire city. In the vicinity are beautiful springs, the most celebrated of which is Wakulla, an immense limestone basin, 16 m. distant. The surrounding country is fertile. The city contains the car and machine shops of the railroad company, and has the only cotton factory in the state. The seminary has separate male and female departments, and is supported by the proceeds of the "seminary lands" granted to the state by congress. There are several free public schools, two weekly newspapers, and Baptist, Episcopal, Methodist, Presbyterian, and Roman Catholic churches.—The site of Tallahassee was selected as the seat of the territorial government in 1822; it was laid out in 1824, and incorporated as a city in 1827. In 1843 the entire business portion, then of wood, was destroyed by fire.

**TALLAHATCHIE,** a river of Mississippi, the principal tributary of the Yazoo, rising in the N. E. part of the state, and flowing in a circuitous but generally S. W. and S. course 250 m. to its junction with the Yalobusha river to form the Yazoo. It is navigable by steamboats more than 100 m.

**TALLAHATCHIE,** a N. W. county of Mississippi, intersected by the Tallahatchie river; area, about 750 sq. m.; pop. in 1870, 7,852, of whom 4,637 were colored. The surface is level and in many places swampy, and the soil fertile. The Mississippi and Tennessee railroad touches the N. E. corner. The chief productions in 1870 were 203,425 bushels of Indian corn, 13,620 of sweet potatoes, and 6,760 bales of cotton. There were 842 horses, 954 mules and asses, 5,500 cattle, 908 sheep, 7,406 swine, and 6 saw mills. Capital, Charleston.

**TALLAPOOSA,** a river of Georgia and Alabama, which rises in Paulding co., Ga., flows S. W., S., and W. 250 m., and unites with the Coosa, forming the Alabama, about 10 m. N. of Montgomery. Its principal affluent is the Little Tallapoosa. It is navigable for steamboats more than 40 m. above the Coosa.

**TALLAPOOSA,** an E. county of Alabama, intersected by the Tallapoosa river, and drained by its branches; area, 700 sq. m.; pop in 1870, 16,963, of whom 4,190 were colored. The surface is hilly and the soil in some parts fertile. The Savannah and Memphis railroad traverses

it. The chief productions in 1870 were 48,468 bushels of wheat, 267,764 of Indian corn, 33,353 of oats, 26,236 of sweet potatoes, 5,446 bales of cotton, and 10,439 lbs. of wool. There were 1,224 horses, 1,198 mules and asses, 8,251 cattle, 3,538 sheep, 12,799 swine, and 26 flour mills. Capital, Dadeville.

**TALLEYRAND - PÉRIGORD, Charles Maurice,** prince de, a French statesman, born in Paris, Feb. 13, 1754, died there, May 17, 1838. He was the eldest son of the count de Talleyrand-Périgord, and, having been lamed by accident when about a year old, was neglected by his family. In 1766 he was placed by an uncle in the college of Harcourt at Paris, and though he there greatly distinguished himself, a family council in 1769 decided that in consequence of his incurable lameness he should give up his birthright to his younger brother, and become a churchman. He was sent immediately to St. Sulpice, and graduated with much distinction at the Sorbonne in 1774. He was then presented at court, and received *in commendam* the abbey of St. Denis in the diocese of Rheims and several other livings. Despite his notorious licentiousness, he was ordained priest soon afterward, and displayed uncommon business tact and brilliant conversational powers. From 1780 to 1785 he held the post of general agent of the French clergy. He mingled in the financial discussions of the time, became acquainted with Mirabeau, Calonne, and Necker, and was noted for his prudence and skill as a speculator. In 1787 he was one of the assembly of notables, and in 1788 was made bishop of Autun, which gave him a yearly income of 60,000 francs. When the states general were summoned in 1789, he was elected one of the deputies of the clergy, insisted that his colleagues should join at once the representatives of the third estate who had assumed the name of "national assembly," figured conspicuously among Mirabeau's friends, and proved a strong supporter of every liberal measure. It was he who moved the celebration of the great patriotic feast, styled the "federation," on July 14, 1790; and in his capacity of bishop, at the head of 200 priests, wearing the national colors over their white robes, he officiated in that solemnity upon the great altar erected in the midst of the Champ de Mars. In the assembly he reported a plan for the reorganization of public instruction, and advocated the abolition of ecclesiastical tithes, the assumption by the government of the lands belonging to the clergy as national property, and the establishment of a civil constitution for that order; and on this constitution being adopted, he consecrated such priests as consented to take the oath to it. This, added to his many deficiencies as a Catholic bishop and his political course, caused him to be excommunicated; but he was secularized by the pope, on condition that he should wear a lay habit and abstain from all clerical functions. In April, 1791, he attended Mirabeau in his last moments, and was charged by the great orator to deliver in the assembly a speech he had prepared upon testamentary powers and the rights of succession. On the dissolution of the constituent assembly, Sept. 30, 1791, Talleyrand was sent, under Chauvelin, on a fruitless mission to England. After the king's fall he retired to England; but, while a warrant was issued against him in Paris by the committee of public safety, he received peremptory orders from the ministry (January, 1794) to leave England in 24 hours. He then sailed for the United States, where through speculation he accumulated a fortune, and carefully studied American institutions and commerce. Before the adjournment of the convention, on motion of Chénier, acting under Mme. de Staël's influence, his name was erased from the list of emigrants; he returned to Paris, found himself a member of the academy of moral and political sciences, was one of the original members of the constitutional club, and in July, 1797, was called to the ministry of foreign affairs. On Bonaparte's return from Italy, Dec. 5, he welcomed him, introduced him to the directors, delivered a speech in his honor at his great official reception, and promoted his subsequent designs. While the young general sailed for Egypt, the diplomatist was to go to Constantinople to reconcile the sultan to the invasion of one of his provinces; he neglected this mission, and continued in office till July, 1799, when he was forced to resign. When Bonaparte returned from Egypt, he again propitiated the conqueror, procured an interview between him and Sieyès, and prevailed upon Barras to resign, thus greatly contributing to the success of the *coup d'état* of the 18th Brumaire. He was rewarded by his reappointment, in November, 1799, as minister of foreign affairs, which office he held till August, 1807, and aided in the reëstablishment of the peace in Europe, taking part in the successful conclusion of the treaties of Lunéville, 1801, and of Amiens, 1802. On June 29, 1802, Pius VII., at Bonaparte's request, released Talleyrand from excommunication; and yielding to Bonaparte's injunction, he married Mme. Grant, with whom he had lived for several years. The pope's refusal to allow this lady to be presented to him filled Talleyrand with resentment; and he is said to have counselled the partition of the Papal States. He prompted the seizure of the duke d'Enghien, and hastened his execution. After the establishment of the empire he received the office of grand chamberlain, and in 1806 the principality of Benevento in Italy. Having vainly advocated an alliance with England, and feeling the growing coldness of the emperor, he resigned his ministerial office, Aug. 9, 1807, and received the title of vice grand elector, to which a large salary was attached. Thenceforward he was only occasionally consulted by his sovereign, but gave very free expression to his views on great political ques-

tions, and was in consequence deprived of his office of chamberlain in 1809; but this only stimulated his sarcastic criticisms against the imperial policy. As early as 1812 he is said to have foretold the approaching overthrow of Napoleon, and on its occurrence he was looked upon at home and abroad as the most influential statesman of the day and the leader of the new revolution. A last interview between him and the emperor in the beginning of 1814 completed the estrangement between them; and Talleyrand, though still a dignitary of the empire and one of the council of regency, thought of nothing but ruining his master. He secretly sent word to the allied sovereigns to hasten toward Paris; and when that city surrendered, March 30, he offered his hotel to the emperor Alexander. His management secured the appointment by the senate, on April 1, of a provisional government, and its formal declaration on the day following of Napoleon's dethronement. While Marshal Marmont was prevailed upon to sign at Essonne (April 3) a convention that baffled Napoleon's last hopes of resisting, Talleyrand welcomed the count of Artois to the French metropolis, April 12, and remained the head of the new government. On the arrival of Louis XVIII. he was appointed (May 12) minister of foreign affairs, holding in fact the premiership in the cabinet; and on June 4 he was made a peer of France. He negotiated the first treaty of Paris, May 30, 1814; and four months later he was sent as minister plenipotentiary to the congress of Vienna, where he failed in protecting the interests of France as well as he desired. He was surprised there by the sudden return of Napoleon from Elba, and participated in the declaration that "outlawed the enemy of nations." He was excepted from the amnesty granted to those who had previously deserted the emperor, went to Ghent, where he joined the exiled king Louis XVIII., accompanied him to France when he returned there after the battle of Waterloo, and resumed, July 8, 1815, the premiership in the cabinet and the ministry of foreign affairs; but being disgusted by the hard terms imposed upon France by the allied powers and by the reactionary tendencies of the new chamber of deputies, he resigned his office at the end of a few weeks. According to another account, having become obnoxious to the emperor Alexander, he was dismissed; but through the duke of Richelieu's entreaties he received the title of grand chamberlain of France, with a salary of 40,000 francs. He still visited the Tuileries, but was coldly received; he retained his seat in the chamber of peers, and delivered there several opposition speeches; but his influence was greatest in social intercourse, his saloon being the gathering place of politicians of every shade of opinion. After the revolution of July, 1830, he was appointed ambassador to England with a princely salary, and negotiated a treaty, April 22, 1834, by which France, England, Spain, and Portugal united for the pacification and settlement of the two peninsular kingdoms. He resigned his office, Jan. 7, 1835, and retired to private life. The most remarkable of his essays is his *Mémoire sur les relations commerciales des États-Unis vers* 1797. He left personal memoirs, which according to his will were not to be published till 30 years after his death. In 1868 Napoleon III. obtained from the heirs a further postponement of 22 years; and in 1872, it having been announced that the memoirs were about to be published, the duke de Montmorency, custodian of the manuscript, refused to violate the pledge given to the late emperor. On the day before his death Talleyrand wrote a letter to the pope enclosing a "retraction" written two months before. The "retraction" deplores his acts which had afflicted the church; and the letter says that his memoirs will explain to posterity the writer's conduct during the revolution.

**TALLIEN, Jean Lambert,** a French revolutionist, born in Paris in 1769, died there in November, 1820. He was the son of the house steward of the marquis de Bercy, who gave him the means of a classical education. In 1791 he started a transient newspaper, *L'Ami du Citoyen*, and became a member of the Jacobin club, and in 1792 clerk of the commune of Paris and deputy to the convention from Seine-et-Oise. He took his seat among the *montagnards*, voted for the death of Louis XVI., and was one of the bitterest opponents of the Girondists. He was sent on a mission to Bordeaux in 1793, and became acquainted with Mme. de Fontenay, whom he married. (See Chimay.) At her instigation he denounced Robespierre and procured his execution, which made him the leader of the Thermidorians. Through his influence Fouquier-Tinville, Carrier, and Lebon were doomed to punishment; and through his energy the revolutionary attempt of the 1st Prairial was baffled. As commissary of the convention with the army of the west in 1795, he ordered all the royalist prisoners made by Hoche on the Quiberon peninsula to be shot. On the 13th Vendémiaire he was among the defenders of the convention against the rebellious sections of Paris. After the establishment of the directorial government he was a member of the council of 500, and shared in the republican *coup d'état* of the 18th Fructidor. In 1798 he accompanied Bonaparte to Egypt as one of the committee of scientific men, and held there a high administrative office. While returning to France he was taken prisoner by the English, and welcomed to London by the whig party. In 1805 he was appointed consul to Alicante; but sickness obliged him to return to Paris, where he received a paltry pension from Napoleon, which he lost in 1811. Mme. Tallien, from whom he was divorced in 1802, had borne him four children.

**TALLOW**, the solid fat of various terrestrial animals, chiefly quadrupeds, which has been separated from the membranous cellular tissue by melting. The ruminants, particularly oxen and sheep, furnish the tallow of commerce. Russia, South America, and Australia furnish the largest proportion. That is esteemed best which is procured from animals that have fed upon dry fodder; hence that of Russia, where animals feed for eight months upon dried grass, is especially valued. Texas and particularly southern California formerly furnished large quantities to commerce. Formerly tallow that had been simply "tried out" or "rendered" was extensively used for candles; very little is now so used, but instead of it the stearine which has been separated from the other constituents is made into candles, which are of more uniform quality and higher melting point. (See Stearic Acid.) Tallow is also largely consumed by soap manufacturers (see Soap), and in the dressing of leather. Tallow consists of several compound acid radicals united with the basic radical of glycerine. Of these, stearine is found in largest quantity, with more or less of palmitine and oleine, depending upon the kind of tallow. In the process of soap making the tallow is decomposed, the potash or soda combining with the stearine, &c., and setting glycerine free.—Vegetable tallow is obtained in China in great quantities from the solid sebaceous covering of the seeds of *Stillingia sebifera*, a tree that is extensively cultivated in that country. (See Tallow Tree.) The tallow, which is brittle, white, opaque, and tasteless, is preferred to animal tallow for making candles. It is regarded as nearly pure stearine. In the United States, the wax-like covering of the berries of the *myrica cerifera* is in some localities used for the same purposes as ordinary tallow, under the name of bayberry tallow. It is hard, of olive-green color, and has a fragrant spicy odor. It is also used to a limited extent in pharmaceutical preparations.

**TALLOW TREE** (*Stillingia sebifera*), a Chinese tree, belonging to the spurge family (*euphorbiaceæ*), growing from 20 to 40 ft., with long and flexible branches, and long-petioled leaves, much resembling those of the poplars, save that they are entire; the flowers are in dense terminal spikes, the upper part of which consists of sterile flowers, with a few fertile ones at the base; the fruit a small three-lobed capsule with one seed in each cell; the seeds are covered with a white tallow-like substance, which gives the tree its common name, and which the Chinese use for candles. This tree is abundantly naturalized in Georgia and South Carolina near the coast, and in Florida on the St. John's. The time and manner of its introduction do not seem to be known; Michaux in 1803 speaks of it as being in cultivation in Charleston and Savannah, and as also growing spontaneously at that time; and Elliott (1824) speaks of the abundance of the fruit, of which no use is made, though it contains much oil. The seeds produce two oily substances: the tallow-like coating which envelops them, and an oil within the kernel itself. To obtain the first, the capsules are cracked without bruising the seeds, the shells separated, and the seeds treated with boiling water and the tallow

Tallow Tree (Stillingia sebifera).

skimmed off; after this, the seeds are crushed and pressed for their oil. The tallow when fresh is creamy white, but it becomes brown on long exposure; the Chinese convert it into candles, which receive a final dip in a mixture of the same substance with some insect wax, which gives them a hard surface and preserves their form in hot weather; the oil is used for lamps; the refuse of the process is used for fuel and for manure. The wood is hard, and is used by the Chinese to make blocks for printing.—Another species, *S. sylvatica*, popularly known as queen's delight, is an herb, 2 or 3 ft. high, with alternate, nearly sessile, oblong-lanceolate, serrate leaves, and a dense terminal yellowish spike of male flowers with a few fertile ones at the base; it is found in light dry soils from Virginia to Florida. The root in large doses is emetic and cathartic; in small doses it is regarded by some southern physicians as influencing the secretions, and it is useful in syphilis and skin diseases.

**TALMA, François Joseph**, a French actor, born in Paris, Jan. 15, 1763, died there, Oct. 19, 1826. He received a collegiate education, and in 1787 appeared at the Théâtre Français in the part of Séïde in Voltaire's *Mahomet*. He early turned his attention to the substitution of contemporary historical dresses for the fancy costumes then worn, a reform which had been previously and unsuccessfully attempted by Lekain, and which Talma finally effected. His first original creation was the principal part in Joseph Chénier's *Charles IX*. Besides the parts he performed in Lafosse's *Manlius*, Racine's *Iphigénie* and *Britannicus*, and Voltaire's

*Œdipe*, he won great applause in Chénier's *Henri VIII.*, and above all in Ducis's *Hamlet*, *Othello*, and *Abufar ;* and under the empire he frequently played before royal audiences. During the restoration some of his most popular performances were political manifestations in disguise; especially in Jouy's *Sylla*, in which his striking resemblance to Napoleon made a great sensation. Since 1796 he had devoted his undivided attention to tragedy; but in 1823 he appeared as Damville in Casimir Delavigne's comedy *L'école des vieillards*, in which he proved a worthy associate of Mlle. Mars. He represented and may be said to have created more than 70 characters. His last and perhaps most perfect creation was the part of Charles VI. in Delavigne's tragedy, and in which he made his last public appearance in June, 1826. In 1855 a statue by David d'Angers, representing Talma in his great part of Sylla, was placed in the Tuileries garden. He left an interesting pamphlet entitled *Réflexions sur Lekain et sur l'art théatral* (8vo, 1815; reprinted in 1856 and 1865). His memoirs by Moreau, by Tissot, and by Duval appeared in 1826; by Laregier, by Lemercier, and by Regnault-Warin, in 1827; and his autobiography, edited by Alexandre Dumas, in 1849–'50 (4 vols. 8vo).—His wife, originally Mlle. Vanhove (born at the Hague, Sept. 10, 1771, died in Paris, April 11, 1860), was one of the most remarkable actresses of her day, but retired from the stage in 1811, nine years after her marriage.

**TALMAGE, Thomas De Witt,** an American clergyman, born in Boundbrook, N. J., Jan. 7, 1832. He graduated at the New York university in 1853, and at the New Brunswick (N. J.) theological seminary in 1856, and was ordained pastor of the Reformed Dutch church in Belleville, N. J. He was pastor of the Reformed Dutch church in Syracuse, N. Y., from 1859 to 1862, when he was called to the second Reformed church in Philadelphia; and in 1869 he became pastor of the Central Presbyterian church in Brooklyn, N. Y., in which office he still continues (1876). In 1870 his congregation erected a new church, semicircular, of wood and iron, and capable of seating 3,400 persons. This building, known as the "Brooklyn Tabernacle," was enlarged in 1871 so as to seat 500 more, but was destroyed by fire Dec. 22, 1872. On Feb. 22, 1874, a new "Tabernacle" was dedicated, built in Gothic style, of brick, but retaining the semicircular arrangement, and seating 5,000 persons. It is the largest Protestant church in America. Since the erection of the former tabernacle the church, at Mr. Talmage's instance, has been free, being maintained wholly by voluntary offerings, with no pew rents. In 1872 he organized in the building formerly occupied by the church a lay college for religious training. It is open to persons of all denominations, and gives instruction in philosophy, logic, and general literature, and in natural and systematic theology, sacred history, the evidences of Christianity, the interpretation of Scripture, and sacred rhetoric. Mr. Talmage is a very popular lecturer, but has latterly seldom appeared in that capacity. His sermons are delivered extempore, but are reported, and published in several religious journals in the United States and Great Britain. He has edited a religious newspaper, "The Christian at Work," since 1874, and has published four volumes of "Sermons" (New York, 1872–'5); "The Almond Tree in Blossom" (Philadelphia, 1870); "Crumbs Swept Up" (1870); "Abominations of Modern Society" (New York, 1872); "Around the Tea Table" (Philadelphia, 1874); "Old Wells Dug Out" (New York, 1874); "Sports that Kill" (1875); and "Every-Day Religion" (1875).

**TALMUD** (late Heb., study), the collective name of the Mishnah and Gemara, containing the oral law and other traditions of the Jews. (See MISHNAH, and HEBREWS, vol. viii., pp. 593–'5.) In a limited sense the term is used of the Gemara alone. The Mishnah constitutes the earlier text of the Talmud, which the Gemara elucidates, not so much in the manner of a running commentary as by furnishing additional textual paragraphs with explanatory remarks, given in the name of renowned scholars. Authority is placed against authority, and discussions in the form of dialogues are frequent. The arguments show keenness, but are often fanciful in the extreme. There are two Gemaras (or Talmuds), the Palestinian (*Yerushalmi*, of Jerusalem) and the Babylonian (*Babli*). The former contains comments on 39, and the latter on 36 treatises of the Mishnah. The Babylonian, which is later, is the principal authority. The Mishnah is in the Hebrew dialect used after the exile; the Gemara in an Aramaic idiom, very corrupt, especially in that of Jerusalem. The rabbis cited in the Mishnah and the Gemara are the representatives of Jewish religious learning during about six centuries, beginning shortly before the time of the Maccabees. The chief commentator is Rabbi Solomon ben Isaac, known under the abbreviation Rashi. The best compendium of Talmudical decisions is the *Mishneh torah* of Maimonides. The editions of the Talmud, mostly in 12 folio volumes, including the most important commentaries and notes, are very numerous. They are so arranged that the Mishnah and Gemara, in square Hebrew characters without vowel points, occupy the centre of the page, and the chief commentaries and notes (Rashi's, *Tosaphoth*, &c.), in a mediæval style of writing, the margins all around. Other commentaries are generally added at the end of each treatise. One of the fullest is the Warsaw edition of the Talmud of Babylon (1859 *et seq.*). An important essay on the Talmud was published by Emanuel Deutsch in the "Quarterly Review" (1869; reprinted in his "Literary Remains," New York, 1873), and another by M. Grünbaum some months later in the "North

American Review." The best Talmudical lexicon is J. Levy's *Wörterbuch über die Talmudim und Midraschim* (Leipsic, 1875 *et seq.*), based, like its predecessors, on Nathan ben Jehiel's *'Arukh*, composed about 1100.

**TAMA,** an E. central county of Iowa, intersected by the Iowa river; area, 720 sq. m.; pop. in 1870, 16,131. The surface is undulating and the soil highly fertile and well timbered. There are rich valleys along the streams, and good water power. It is intersected by the Chicago and Northwestern railroad. The chief productions in 1870 were 1,054,167 bushels of wheat, 1,103,371 of Indian corn, 282,591 of oats, 23,588 of barley, 88,616 of potatoes, 17,080 lbs. of wool, 407,567 of butter, and 25,854 tons of hay. There were 7,959 horses, 6,073 milch cows, 9,218 other cattle, 4,547 sheep, and 17,646 swine; 11 manufactories of carriages and wagons, 3 of furniture, 3 of lime, 5 of saddlery and harness, 8 flour mills, and 3 saw mills. Capital, Toledo.

**TAMANDUA.** See Ant-Eater.

**TAMAQUA,** a borough of Schuylkill co., Pennsylvania, on the Little Schuylkill river and on branches of the Philadelphia and Reading railroad and the Central railroad of New Jersey, 16 m. E. N. E. of Pottsville and 60 m. N. E. of Harrisburg; pop. in 1870, 5,960; in 1875, about 7,000. It is in a rich coal and iron region, and has good water power. It contains three machine shops and founderies (one of them the largest in the state), stove works, a boot and shoe factory, a rolling mill, two saw mills and sash factories, a spike factory, a brick kiln, a powder mill, a tannery, a lime kiln, two breweries, seven or eight bottling establishments, a gun factory, two screen factories, and two saddle and harness factories, besides shops of the Philadelphia and Reading railroad company. It has a fire department, a national bank, a banking and trust company, three brick school houses, a daily and a weekly newspaper, and ten churches.

**TAMARACK.** See Larch.

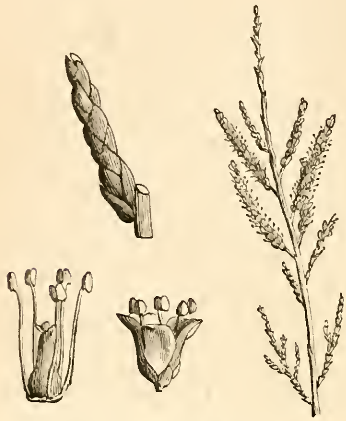
**TAMARIND,** the fruit of a leguminous tree, *tamarindus Indica*, the common and botanical name being derived from the Arabs, who, having learned of the fruit from the Hindoos, called it *tamare-hindi*, the Indian date. The tree is indigenous to various parts of Africa, and probably also to India, and it grows wild in several of the East Indian islands; it was early introduced into the West Indies, and is completely naturalized there, and also in portions of Brazil and Mexico. There is only one species of the genus. It is a large handsome tree, 60 to 80 ft. high; its compound leaves, of 10 to 20 pairs of small oblong leaflets, form a dense foliage; the flowers, white when they first open, but soon turning yellow, have purple and brown stamens, are borne in racemes, and are fragrant; the fruit is an indehiscent legume or pod, 3 to 6 in. long, straight or curved, thick, and with a hard, brittle exterior shell; the seeds, from 4 to 12, are each surrounded by a tough papery membrane, outside of which, and between it and the shell, is a firm, juicy, very acid pulp, traversed by strong woody fibres, which start from the fruit stalk and run through, throwing off branches, to the opposite end (apex) of the pod. The ripeness of the pods is known by the brittleness of the outer shell; they are picked, and in the West Indies deprived of the shell and packed in a cask, and boiling sirup is poured over them until the vessel is full; when cool the package is headed up and is ready for market. A better kind, rarely found on sale, is prepared by packing the shelled fruit in stone jars, with alternate layers of sugar. In the East Indies the fruit is usually preserved without sugar; the shell is removed and the pulp and seed are kneaded into a mass, and in this form tamarinds are chiefly used on the continent of Europe. The pulp has a brisk acid taste, modified more or less by the amount of sugar used; it contains tartaric, citric, and other acids, and some principle not well ascertained which gives it a laxative property. Tamarinds are used, especially in tropical countries, to prepare a refreshing drink, by pouring boiling water

Tamarind (Tamarindus Indica).

over the fruit; this drink is also used as a laxative and refrigerant in fevers. By boiling the preserved fruit with a small quantity of water, and sifting, the pulp is obtained pure; it is used as an article of diet, and it enters into the composition of a popular laxative, the compound confection of senna. The wood is useful for timber, and makes a fine charcoal. The shell of the seeds is astringent and contains tannin; their kernels are used as food in India in times of scarcity.

**TAMARISK,** the name of ornamental shrubs of the genus *tamarix* (the ancient name, supposed to be from the river Tamaris), of a small family (*tamariscineæ*) closely related to the pink family. The genus belongs to the old world, and the more than 50 described species are reducible to about 20, all shrubs or small trees, with minute scale-like or awl-shaped, alternate leaves, which are appressed, and small purplish flowers in terminal spikes or racemes; the parts of the flower are in fours or fives; it has a one-celled ovary, ripening into a pod

with many seeds, each of which has a small tuft of hairs. The common tamarisk (*T. Gallica*) is abundant on the Mediterranean and Atlantic coasts of Europe, and, though spontaneous in England, is thought to have been introduced there; from its slender graceful



Common Tamarisk (Tamarix Gallica).

habit, and the abundant though not showy flowers, this is deserving of a place among shrubbery; in the northern states it is often killed to the ground in severe winters. *T. Africana* and others are offered in the catalogues, but there is much confusion as to names. *T. mannifera* of the East (regarded by some botanists as a variety of *T. Gallica*) is supposed by some to be the plant the manna from which fed the Hebrews. (See MANNA.) Tamarisk manna is produced in small drops from the *T. Gallica* in Arabia, the branches having been punctured by an insect. Tamarisk galls are found upon *T. orientalis*, in N. W. India, and are used in India instead of oak galls.

**TAMATAVE,** a town and the principal port of Madagascar, on the E. coast, in lat. 18° 10′ S., lon. 49° 28′ E.; pop. about 7,500. It is built on a point about 350 yards wide, with low sand hills behind it. Nearly all the buildings, excepting a few belonging to foreign residents, are in the native style, with high roofs thatched with rushes. The town has a large trade with the interior, and is fast increasing in commercial importance. The total value of imports in 1873 was $487,255; of exports, $360,930. The principal imports are sheetings, calico, rum, brandy, shoes, and salt; exports, beef, hides, and India rubber. The duties are 10 per cent. in kind on imports, and 10 per cent. in money on exports.

**TAMAULIPAS** (formerly Nuevo Santander), an E. state of Mexico, bounded N. by Texas, E. by the gulf of Mexico, S. by Vera Cruz, and W. by San Luis Potosí and Nuevo Leon; area, 28,659 sq. m.; pop. in 1871, 108,778. The coast is low and sandy, and several lagoons extend along the shore, the largest being the laguna Madre, more than 100 m. long, and in some places 20 m. wide. The Rio Grande del Norte forms the northern boundary line; other rivers are the Fernando or Tigre, Borbon, Santander, and Tampico; the mouths of all are so much encumbered with bars that they are almost useless for navigation. In the northern part of the state the flat country extends inland for some distance, and the surface then rises into elevated plains; but in the south it is diversified by numerous mountains and fine valleys. During the hot season the climate on the coast is unhealthful, but in the elevated parts of the interior it is temperate and agreeable. There are rich silver and copper mines, but they are little worked. The forests abound in valuable timber. Much of the soil is very fertile, and the grains, vegetables, and fruits of the temperate and torrid zones are easily grown; but little attention is paid to agriculture. Vast numbers of cattle, and to a less extent horses, mules, goats, and sheep, are reared. The chief towns are Ciudad Victoria, the capital, Matamoros, and Tampico.

**TAMBERLIK, Enrico,** an Italian singer, born in Rome in 1820. He made his début at the Teatro del Fondo in Naples in 1841, and subsequently sang in Spain, South America, England, and St. Petersburg, in which city he appeared for 18 consecutive seasons. He visited the United States in 1875, but without success, his voice being impaired.

**TAMBOURINE,** an instrument of the drum species, consisting of a wooden or metal hoop, over which parchment is distended, and which is hung with a set of bells. It is held in either hand and beaten with the knuckles of the other. Certain peculiar effects of sound are produced by rubbing the parchment briskly with the thumb. The tambourine is one of the most ancient instruments known, and, from the graceful use which can be made of it, has always been a favorite with dancers.

**TAMBOV.** I. A S. E. government of European Russia, bordering on Vladimir, Nizhegorod, Penza, Saratov, Voronezh, Orel, Tula, and Riazan; area, 25,683 sq. m.; pop. in 1870, 2,150,971. It is level, and partly traversed by steppes in the south. The chief rivers are the Tzna, Moksha, and Vorona, the banks of which are swampy and covered with forests. Grain, hemp, flax, and poppies are raised, especially in the southern part. The other products include timber, peat, iron, saltpetre, and sulphur; and there are many mineral springs. The government is celebrated for its horse markets and studs. II. A city, capital of the government, 260 m. S. E. of Moscow; pop. in 1867, 28,617. It is the seat of a bishop, and has many churches, schools, and charitable institutions, and manufactories of tallow, woollens, sail cloth, &c. The annual markets are celebrated. Gardens and fine streets make it one of the pleasantest of provincial cities.

**TAMBURINI, Antonio,** an Italian singer, born in Faenza, March 28, 1800. After several

years' practice in the theatre and churches of his native city, he made his public début at Bologna in 1818, and soon rose into great celebrity in Italy. In 1832 he first appeared in London and Paris, and thenceforth visited them annually until his retirement in 1854, when he settled at Sèvres, France. With Grisi, Rubini, and Lablache, he was one of the original performers in Bellini's *Puritani*, and for several seasons continued a member of that remarkable quartet. His voice, a baritone of great power and sweetness, was shown to the best effect in the operas of Rossini, Bellini, and Donizetti, and he was also an excellent actor both in serious and buffo opera. His finest parts were Figaro and Don Giovanni.

**TAMBURINI, Pietro,** an Italian theologian, born in Brescia in 1737, died in Pavia in March, 1827. In 1772, while professor in the seminary of Brescia, he was appointed by Pope Clement XIV. prefect of studies in the Irish college of San Isidoro at Rome. In 1778 he was appointed by the empress Maria Theresa professor of theology at Pavia and director of studies in the Germano-Hungarian college in that city. In 1795 he resigned his professorship, but in 1797 the French authorities in Lombardy compelled him to fill the chair of ethics and international law in the university. This chair was suppressed in 1798, but restored in 1801, and filled by him till 1818, when he was appointed dean of the faculty of law. He published *Idea della Santa Sede* (Pavia, 1784), in which he opposed the doctrine of papal official infallibility, while maintaining the jurisdictional supremacy of the Roman see; *Introduzione allo studio della filosofia* (Milan, 1797); *Lezioni di filosofia morale, e di naturale e sociale diritto* (4 vols., Pavia, 1806–'12); *Elementa Juris Naturæ* (Milan, 1815); and *Cenni sulla perfettibilità dell' umana famiglia* (Milan, 1823).

**TAMERLANE.** See Timour.

**TAMILS, or Tamuls.** See India, Races and Languages of, vol. ix., p. 215.

**TAMPICO, or Santa Aña de Tamaulipas,** a seaport town of Mexico, in the state of Tamaulipas, on the river Pánuco, 5 m. from the gulf of Mexico, and 235 m. N. N. W. of Vera Cruz; pop. about 5,500. It is on rising ground, with wide streets crossing at right angles. The houses are mostly of stone, and there are two churches, a custom house, two hospitals, a prison, and some monuments. The harbor is not very safe, and has a dangerous bar. The commerce is principally with New York, New Orleans, and Liverpool, and to the latter port there is a regular line of steamers. For the year ending Sept. 30, 1874, the value of imports was $715,821; of exports, $1,836,472, including $1,264,015 specie.

**TANAGER,** a name given to the *tanagrinæ*, a very large division of the finch family, peculiar to America, and almost entirely confined to the southern portion of the continent, which contains nearly 200 of the more than 220 species described by Sclater. The bill has the upper mandible notched, and is usually triangular at the base and arched; the toes have strong claws, and the hind toe is long and strong. They are small and brilliant birds, the prevailing colors being orange, scarlet, and black; many have a pleasing song, and a few are remarkable for their musical powers; their flight is rapid, movements active, and habits arboreal; most unite in flocks, often in the neighborhood of human habitations, but a few are solitary; the food consists of insects, fruits, and seeds. Of the 20 genera, only a few of the common ones can be here noticed.—In the genus *pyranga* (Vieill.) the wings are long and pointed, the second quill nearly as long as the third, which is longest; tail moderate and nearly even. One of the most richly colored of North American birds is the scarlet tanager (*P. rubra*, Vieill.), about 7¼ in. long and 11¾ in. in alar extent; the male in the breeding season is of a general bright carmine color, with the wings and notched tail velvety black; the female is dull yellowish green, which is also the color of the young and the other sex in autumn and winter.

Scarlet Tanager (Pyranga rubra).

It enters the United States from Mexico early in April, arriving in New Jersey about the middle of May; it goes as far north inland as Lake Huron, and has been found breeding in New Brunswick and Nova Scotia; it is very sensitive to cold; its migrations are performed at night; its notes are lively, but not musical according to Wilson, resembling the syllables "chip, churr." The change from the winter to the summer plumage takes place very rapidly; it is shy and unsociable, preferring the deep recesses of forests, and rarely approaching human habitations in crowded villages; the food consists of fruits and insects, especially wasps and bees. As in the subfamily generally, the nest is thin and coarsely made; the eggs are three to five, dull greenish blue with brown and purple specks, and are seven eighths by five eighths of an inch in size. This species is found from the eastern states to Missouri. The Mississippi tanager or summer red bird (*P. æstiva*, Vieill.) is 7¼ in. long and 11 in. in alar extent; the color is light red, brightest on the head, the back dusky, and the quills and shafts of tail feathers brown; bill light horn

color, and the gape, as in others of the genus, well provided with bristles bending downward; the females olive above and reddish yellow below, as are the young males; the color is lighter and more rosy than in the scarlet tanager, and the bill is much larger. It is found in the S. Atlantic and gulf states and Guatemala, is so sensitive to cold that it rarely goes further north than Massachusetts, and is not seen in the southern states after the middle of September; it is of solitary habits, preferring growths of stunted hickories and oaks. The song is like the syllables "chicky, chucky, chuck," and is chiefly at night; the food consists of insects, especially large beetles, taken on the wing; the nest is rudely made and insecurely fastened to its supporting branch; the eggs are four or five, light blue, and are incubated for 12 days by both sexes. In the genus *tanagra* (Linn.) the bill is short, elevated at base, rather triangular; the wings moderate, with the third and fourth quills longest. There are many species, all South American, living in troops; the nest is carelessly made. The bishop tanager (*T. episcopus*, Linn.) is purplish violet, with the small wing coverts bluish white, the middle shaded with violet, the larger ashy, and the wings and tail blackish bordered with blue.—The genus *calliste* (Boie) comprises about 30 species of the most beautifully variegated of tropical birds, all inhabitants of the dense South American forests. The best known species is the festive tanager (*C. festiva*, Boie), which has the throat and crown blue, forehead and upper back black, collar scarlet, rest of plumage parrot green. The celebrated *organista*, remarkable for the sweetness and great compass of its voice, belongs to the genus *euphonia*.

**TANAIS.** See DON.

**TANANARIVO**, or **Antananarivo**, a city of Madagascar, capital of the province of Imerne in the territory of Ankova, and the residence of the so-called sovereign (now queen) of Madagascar, near the middle of the island, in lat. 18° 56′ S., lon. 47° 28′ E.; pop. about 75,000. It is on a long irregular hill in the midst of a highly cultivated valley, 18 m. long by 10 m. wide, and 7,000 ft. above the sea. The houses of the better classes are substantially constructed of wood, with high bamboo roofs thatched with rushes; those of the poorer classes are of split bamboo covered with mats. The palace, on the summit of the hill, is rectangular, about 60 ft. high, with a tall roof pierced with three rows of windows, and with double verandas. A smaller palace near by is the residence of the prince royal, and the houses of the chief nobles and military officers are in the immediate vicinity. N. of the palace is a natural amphitheatre, capable of holding 100,000 persons, where large public assemblies are held. Courts are held in the open air W. of the palace, and a little beyond is a precipice 300 ft. high, down which those convicted of witchcraft and sorcery are thrown. Through the efforts of the missionaries a marked improvement has taken place of late years in the habits and manner of life of the people, who have adopted many European customs. Schools and chapels have been established, printing offices opened, and many thousand Bibles and other books printed.

**TANCRED**, an Italian crusader, born in 1078, died in Antioch in 1112. He was a son of the marquis Odo or Ottobonus and of Emma, a daughter of Tancred de Hauteville and sister of Robert Guiscard, duke of Apulia. He took the cross under his cousin Bohemond, son of Robert Guiscard, made over his heritage to his younger brother, and embarked in 1096 from Taranto. In the plains of Chalcedon his troops joined those of Godfrey of Bouillon, with whom he formed an intimate friendship. At the siege of Nicæa in 1097 he distinguished himself, at the battle of Dorylæum saved the army of the cross from destruction, and after the taking of Nicæa led the advanced guard through Asia Minor. He took possession of Tarsus and Malmistra, to both of which Baldwin laid claim, giving rise to a bitter quarrel; but they were afterward reconciled. He achieved great distinction during the siege of Antioch; and at the storming of Jerusalem he was one of the first to mount the walls. In the carnage and rapine which followed, he almost alone of the Christian knights manifested compassion, and at the risk of his own life saved thousands of the captured. When the sultan of Egypt marched toward Jerusalem, Tancred defeated his advanced guard, and shared in the subsequent victory at Ascalon, Aug. 12, 1099. He afterward took Tiberias, beleaguered Jaffa, and was made prince of Tiberias or Galilee. Bohemond, now prince of Antioch, being taken prisoner by the Saracens, Tancred marched to his relief, and administered his government during his detention; and when Bohemond after his release went to Europe to arm the West against the Byzantine empire, he left the defence of Antioch to Tancred. During his absence his principality was attacked on all sides, but was heroically defended by Tancred, who reduced Artesia, besieged Tripoli in 1109, and subsequently withstood in Antioch a severe siege from the Saracens. Bohemond died at Salerno, and the host he had collected was scattered. Tancred now resumed the offensive, defeated the Saracens, and forced the sultan to evacuate Syria. His exploits have been celebrated, partly in prose, partly in verse, by Raoul de Caen, in *Les gestes de Tancrède;* and he is one of the principal characters of Tasso's "Jerusalem Delivered."

**TANEY**, a S. W. county of Missouri, bordering on Arkansas, and drained by White river and its affluents; area, about 700 sq. m.; pop. in 1870, 4,407, of whom 10 were colored. The surface is hilly, and the soil fertile. The chief productions in 1870 were 6,375 bushels of wheat, 135,577 of Indian corn, 11,075 of oats, and 48,250 lbs. of butter. There were 1,163

horses, 1,025 milch cows, 1,594 other cattle, 3,189 sheep, and 9,500 swine. Capital, Forsyth.

**TANEY, Roger Brooke,** an American jurist, born in Calvert co., Md., March 17, 1777, died in Washington, D. C., Oct. 12, 1864. He belonged to a Roman Catholic family, graduated at Dickinson college, Pa., in 1795, was admitted to the bar in 1799, commenced practice in his native county, and was elected a delegate to the general assembly as a federalist. In 1801 he removed to Frederick, and in 1816 was elected to the state senate. In 1822 he removed to Baltimore, where he continued to reside until his death. In 1824 he identified himself with the supporters of Gen. Jackson, but was nevertheless made attorney general of the state by the federal governor in 1827. In 1831 he was appointed by President Jackson attorney general of the United States. He supported the president in his controversy with the United States bank, and in September, 1833, was appointed secretary of the treasury on the dismissal of Mr. Duane from that office; and he immediately issued orders for the removal of the government deposits from the United States bank to the local banks selected by him as agents of the government. When his nomination was communicated to the senate, that body rejected it by a vote of 28 to 18. In 1835 he was nominated to fill a vacancy on the bench of the supreme court, but was not confirmed by the senate. When Chief Justice Marshall died, and the president nominated Mr. Taney as his successor, the senate, now having an administration majority, confirmed the nomination, and he took his seat upon the bench in January, 1837. In the decision of the questions which came before him as a judge he displayed great ability; and though his views of constitutional law were less in the direction of centralization than those of his predecessor, he did not fail to sustain to the fullest extent the powers which he believed were justly claimed for the federal government. A striking illustration of this is the case of Ableman *v.* Booth, 21 Howard, 506 (1859), in which he denied the right of the state courts to inquire into the validity of imprisonment by or under a claim of federal authority, and asserted exclusive jurisdiction for that purpose in the federal courts; a decision opposed to the general practice that had before prevailed, but which has recently been reaffirmed by the court. The most noted of his decisions was that in Dred Scott *v.* Sandford, 19 Howard, 393. In that case Scott, who was held as a slave in Missouri, brought suit to recover his freedom, suing in the federal court on the ground of being a citizen of a different state from the defendant, and claiming his freedom because of having been taken by his master into territory made free by the act of congress commonly called the Missouri compromise. The case, having been decided in the circuit court, was removed to the supreme court. The decision (1857) declared that Scott was not entitled to bring suit in the federal court, because he was not a citizen; the chief justice in an elaborate opinion declaring that for more than a century previous to the adoption of the declaration of independence negroes, whether slave or free, had been regarded "as beings of an inferior order, and altogether unfit to associate with the white race, either in social or political relations; and so far inferior that they had no rights which the white man was bound to respect." Having reached this conclusion, which of itself put an end to the case, the court went further, and considered the main question involved, namely, whether it was competent for congress to exclude slavery from the territories of the Union; and the majority, Justices McLean and Curtis dissenting, denied the power. The party dissatisfied with this conclusion made it the occasion for a severe arraignment of the court, not only because of the views held as to the right to legislate against slavery, but because those views were expressed in a case not calling for them, inasmuch as the court had already decided that it had no jurisdiction. The decision, in its denial of the right of citizenship to negroes, was disregarded by the executive department after Mr. Lincoln became president, and by the judicial also when Mr. Chase became chief justice and admitted colored persons as practitioners in the federal courts. In May, 1861, Chief Justice Taney was applied to for a writ of *habeas corpus* on behalf of John Merryman of Baltimore, who had been arrested under the orders of a federal general, and promptly issued the writ. The officer to whom it was addressed declined to obey, on the ground that Merryman had been arrested on a charge of treason, and that the officer had been duly empowered by the president to suspend the writ of *habeas corpus*. Upon this the chief justice ordered an attachment to issue, but as it was impossible to serve this, he wrote out his opinion denying to the president the power to suspend the writ of *habeas corpus*, and insisting that it could only be done by legislative authority. To this opinion no attention was paid at the time, but congress soon passed the necessary law to meet the objection. A memoir of his life, prepared at his request by his friend Prof. Samuel Tyler (Baltimore, 1872), includes his autobiography, which only comes down to 1801. A bronze statue of him by Rinehart, ordered by the state of Maryland, was unveiled in Annapolis, Dec. 10, 1872.

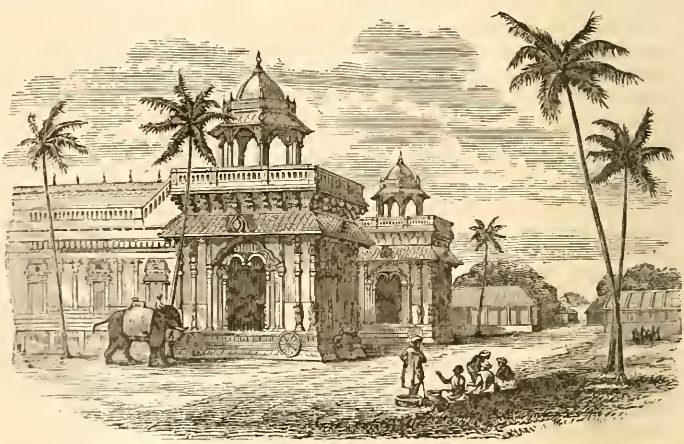
**TANGANYIKA** (the meeting place of waters), a lake in central Africa, discovered by Burton and Speke on Feb. 13, 1858. It occupies a long depression in a region of considerable elevation, S. of the Victoria and Albert lakes and N. W. of Lake Nyassa. It is included between lat. 3° and 9° S., and lon. 29° and 32° 30′ E., and extends about 400 m. in a N. W. and S. E. direction, its width varying from 10 to 60 m. Its height above the level of the sea,

according to the latest observations (made by Lieut. L. V. Cameron, R. N., 1874), is 2,711·2 ft. The water is deep and pure, though peculiar in taste. The northern portion of the lake, which was thoroughly explored by Livingstone, lies between the 29th and 30th meridians, and narrows as it trends northward, being largely hemmed in by mountains on or near the coast. Nearest the W. shore, just S. of the 4th parallel, is the large island of Mozima, 40 m. long. At its N. extremity the lake receives the waters of the Rusizi. S. of lat. 6° the lake is wholly E. of the 30th meridian. The E. coast is hilly. The wide bay which forms the S. extremity of Tanganyika is the Lake Liemba of Livingstone. Between lat. 6° and 7° the W. coast rises into mountains 2,500 ft. high, wooded to their summits. On both sides innumerable small streams and many considerable rivers flow into the lake. The river Lukuga, discovered by Lieut. Cameron on the W. coast in May, 1874, which is 300 to 500 yards wide and from three to five fathoms deep, leaves the lake, near lat. 6°, with a current of 1·2 knot an hour. This explorer traced the river four or five miles, until his boats were stopped by the density of the aquatic vegetation.—The hydrographic relations of Lake Tanganyika have been the subject of much controversy. As to its asserted connection with the Nile system, see NILE. According to native information, the Lukuga flows into Livingstone's Lualaba, but Capt. Burton regards this outlet as really such only in the season of floods, when it acts as a surplus drain, becoming in turn a tributary to the lake in the dry season; a view which is evidently founded on Livingstone's observation that from February to November the surface water of the lake, as seen at Ujiji, moves northward at the rate of about a mile an hour, while during the remainder of the year there is a similar gentle movement in the opposite direction. — The shores of the lake are rich in beautiful scenery, and in many portions are thickly inhabited. The principal place upon it is the town of Ujiji, on the E. coast.

**TANGIER,** or **Tangiers** (Moorish, *Tanja*), a city and seaport of Morocco, near the W. entrance of the strait of Gibraltar, in lat 35° 47′ N., lon. 5° 48′ W.; pop. about 12,000. It is on high ground overlooking a spacious bay, surrounded by a wall, and defended by several forts. Its streets are narrow and dirty. The harbor was once good, but is now so filled up with sand that vessels of 300 or 400 tons only can enter it. The entrances in 1873 were 525 vessels, tonnage 48,956; clearances 520, tonnage 49,036. The total value of the imports was $1,758,125, of which $600,000 was in specie; of the exports, $1,216,080. Its trade consists principally in supplying Gibraltar, Cadiz, and Lisbon with provisions.—Tangier is the ancient Tingis, supposed to have been founded by the Carthaginians. It was an important city under the Romans, and under Claudius became the capital of Mauritania Tingitana. In 1471 it fell into the hands of the Portuguese, who held it till 1662, when it was ceded to England as a part of the dowry of Catharine of Braganza, queen of Charles II. The British abandoned it in 1684, after destroying the mole which they had built. In 1844 it was bombarded by the French.

**TANGIPAHOA,** a S. E. parish of Louisiana, bounded N. by Mississippi and S. by Lakes Pontchartrain and Maurepas, and intersected by the Tangipahoa river; area, about 720 sq. m.; pop. in 1870, 7,928, of whom 2,994 were colored; in 1875, 7,248, of whom 3,196 were colored. The surface is low and level, and the soil in some parts fertile, in others sandy. It is traversed by the New Orleans, Jackson, and Great Northern railroad. The chief productions in 1870 were 64,023 bushels of Indian corn, 35,809 of sweet potatoes, 1,642 bales of cotton, 20,423 lbs. of butter, 9,071 of wool, and 57,030 of rice. There were 772 horses, 1,480 milch cows, 4,877 other cattle, 3,457 sheep, and 6,270 swine. Capital, Amite City.

**TANJORE. I.** A district of Madras, British India, bounded N. by Trichinopoly and South Arcot, E. and S. E. by the bay of Bengal, S. and S. W. by Madura, and W. by Trichinopoly and the dependent native state of Poodoocottah; area, 3,736 sq. m.; pop. in 1872, 1,975,042. There are no important harbors. The



The Palace, Tanjore.

country is watered by the Coleroon and Cavery and their numerous branches. There are 64 irrigation tanks in the district, and extensive works connected with the rivers, so that the entire area of irrigation in 1872-'3 was 748,673 acres. The surface consists for the most part of an extensive plain of great fertility. Cotton goods are manufactured, and salt is made in the neighborhood of Point Calymere. The inhabitants are nearly all Hindoos, and their institutions have been more perfectly preserved than in most other parts of India. The district forms the inland boundary of the French coast settlement of Carical. **II.** A city, capital of the district, on a branch of the Cavery, 180 m. S. W. of Madras and 45 m. from the bay of Bengal; pop. about 80,000. It contains two forts, the greater about 4 m. in circumference and the lesser about 1 m., both strong and well constructed. The rajah's palace stands in the centre of the great fort. The pagoda in the small fort is considered the finest building of the kind in India. The manufactures consist of silk, muslin, and cotton goods. Tanjore was founded about A. D. 214, and became the capital of a Hindoo principality of the same name, which was absorbed by the Mahrattas in the 17th century. The British assumed the government about the year 1800.

**TANNAHILL, Robert,** a Scottish poet, born in Paisley, June 3, 1774, died May 17, 1810. He worked all his life as a weaver. His volume of "Poems and Songs" (1807) became very popular; but while revising it he fell into a state of despondency, aggravated by the refusal of Constable to print a new edition, burned all his new and revised poems, and drowned himself. An enlarged edition of his remains, with a memoir, was published at Glasgow in 1838, and reprinted at Paisley in 1874.

**TANNIC ACID, or Tannin.** The astringent principles existing in a great variety of plants, which render them capable of combining with the skins of animals to form leather, of precipitating gelatine, of forming bluish black precipitates with the per-salts of iron (or if a free acid be present a dark green color), were formerly termed tannin. These substances, being found to possess acid properties, are now known as tannic acid, and various distinctive names are given to them as they are found of different chemical compositions, though agreeing in their essential properties. Thus the tannic acid derived from the gall nut is termed gallotannic acid; that of the oak, quercitannic acid; of the fustic (*morus tinctoria*), moritannic acid; of the cinchona, quinotannic acid, &c. The principal sources of tannin have been named in the article LEATHER, and the method of extracting it has been particularly described in the article on GALLS, which are the most abundant source of it. Besides this variety, which is the same as that existing in the bark and leaves of many forest trees, fruit trees, and shrubs, and in some roots, as those of the tormentilla and bistort, there is another less known, as the tannin of the catechu and kino, which precipitates the salts of iron dark green instead of blue. Gallotannic acid when pure is a whitish, uncrystallizable solid substance, without odor, intensely astringent to the taste; it dissolves freely in water, to a less extent in dilute alcohol, and sparingly in ether. The best solvent for medical uses is glycerine. It changes blue litmus paper to red, and expels carbonic acid from its compounds with effervescence. Its formula is $C_{27}H_{22}O_{17}$. Its aqueous solution exposed to the air absorbs oxygen, and is converted into gallic acid. Besides its use in tanning, gallotannic acid is employed to produce with the salts of iron the gallotannate of iron, which is the basis of most of the writing inks. It is also employed in medicine for its astringent property, chiefly in checking hæmorrhages, as a wash for ulcers, ophthalmic affections, &c. If taken internally in large quantities, it is an irritant; but in small doses it is absorbed and makes its appearance in the urine as gallic acid, having undergone a process of oxidation in the organism. The combinations of tannic acid with iron and with lead have been applied in the form of ointments to the dressing of ringworms, gangrenous sores, &c.

**TANNING.** See LEATHER, vol. x., p. 275.

**TANSY** (Fr. *athanasie*, contracted to *tanaisie*, from Gr. ἀθανασία, immortality, in allusion

Tansy (Tanacetum vulgare).

to some supposed preservative quality of the plant, or to its durable flowers), *tanacetum vulgare*, a plant of the composite family, a native of Europe, which was formerly cultivated, but has escaped from gardens and become a common roadside weed. It is a perennial herb, with large, twice or thrice pinnately divided, deep green leaves, and stems 2 to 4 ft. high, bearing corymbs of heads of golden yellow flowers, which are nearly all tubular and fertile. A variety called double tansy has the

leaves more cut and crisped. The leaves have a strong fragrance, due to a volatile oil, and a bitter, aromatic taste, and have long been in use infused in spirits as a domestic aromatic tonic; in former times it was held in much esteem as a remedy in dropsy, and as a worm-destroying medicine. The volatile oil is kept in the shops, and is popularly supposed to produce abortion; it is highly poisonous, and its use for criminal purposes has often killed the mother. The green leaves were formerly used in cookery, but have been superseded by foreign spices, though tansy puddings are still made in England.—A native species, *T. Huronense*, found in Maine and on the great lakes, is only of botanical interest.

**TANTALUM.** See Columbium.

**TANTALUS,** a character of Greek mythology, differently described as king of Argos, Corinth, Lydia, or Paphlagonia. Having given offence to the gods, he was punished in the lower world by confinement in a lake, where he was tormented with thirst, yet could not drink, for the waters always receded from his lips. Branches laden with fruit hung over his head, and when he stretched forth his hand to take the fruit the branches withdrew.

**TAOS,** the N. W. county of New Mexico, bordering on Colorado and Arizona; area, about 7,500 sq. m.; pop. in 1870, 12,079. It is watered by the Rio Grande and the Rio de Chama, one of its tributaries, and by the San Juan, a branch of the Colorado, and is crossed by several spurs of the Rocky mountains. Gold mining is carried on to some extent. The chief productions in 1870 were 153,799 bushels of wheat, 80,224 of Indian corn, 21,542 of oats, 15,040 of peas and beans, 2,323 of potatoes, and 90,503 lbs. of wool. There were 1,043 horses, 999 mules and asses, 924 milch cows, 2,600 working oxen, 4,104 other cattle, 81,108 sheep, and 688 swine; 2 flour mills, and 1 quartz mill. Capital, Fernandez de Taos.

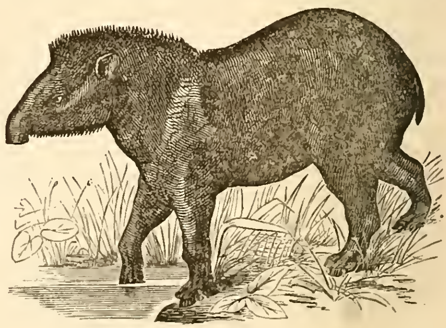
**TAPE GRASS.** See Valisneria.

**TAPESTRY** (Gr. τάπης, a carpet), an ornamental figured cloth, used for lining the walls of apartments, or for covering articles of furniture. The Egyptians and Hebrews attained great skill in ornamenting textile fabrics by colored yarns worked in by the hand, and also by the loom. The art was early introduced into France, and about the 9th century tapestry was made with the loom; but the fabrication with the needle continued as an occupation for ladies of the highest rank. Up to the 12th century the use of tapestry was limited to the adornment of churches and monasteries; but after this period it began to be adopted in dwellings. In France the workmen employed in the manufacture were originally called *sarazins* and *sarazinois*, indicating the origin of the art as derived from the Saracens. The finest work in the 14th and 15th centuries was produced by the Flemings, and about this period the principal manufactories in the west of Europe were at Bruges, Antwerp, Arras, Brussels, Lille, Tournay, and Valenciennes. Florence and Venice at that time produced very rich and costly tapestry; but in the 16th century the more ornamental work with threads of gold and silver was introduced in the manufacture of Fontainebleau. One of the most famous pieces is the Bayeux tapestry, commemorating the Norman conquest of England. (See Bayeux Tapestry.) About the end of the reign of Henry VIII. the art of weaving tapestry was introduced into England. In the reign of James I. the manufacture was established at Mortlake in Surrey under royal patronage. For the earlier designs old patterns were employed, but afterward original scenes were furnished by Francis Cleyn. The method of weaving tapestry in what is called the *haute-lisse* or high warp has been described in the article Gobelins.—See *Notice historique et descriptive sur la tapisserie dite la reine Mathilde*, by the abbé Laffetay (Bayeux, 1874); and "The Bayeux Tapestry, reproduced in Autotype Plates, with Historic Notes by Frank Rede Fowke" (Arundel society, London, 1875).

**TAPEWORM.** See Entozoa, vol. vi., p. 663.

**TAPIOCA.** See Cassava.

**TAPIR** (*tapirus*, Cuv.), a genus of ungulate mammals, characterized by a nose prolonged into a short, movable proboscis; skin very thick and covered with close short hair, the neck furnished with a kind of stiff mane; tail very short; ears small, erect, and pig-like; four toes on the fore and three on the hind feet, separate and ending in nail-like hoofs; skull pyramidal as in the hog, with the nasal bones much arched for the muscles of the proboscis; teeth, 6 incisors and 2 small canines in each jaw, and molars 14 above and 12 below. The tapirs look like hogs, but the legs are longer; they inhabit the moist tropical forests of South America and of the Malayan peninsula and archipelago, usually sleeping by day in retired places, and feeding at night on fruits, grasses, and other vegetable substances, though they



American Tapir (Tapirus Americanus).

are as omnivorous as the hog; like their congeners, they are fond of rolling in the mud and water, and are excellent swimmers; they are gentle and easily tamed; when pursued they

take to the water if possible, where they easily defend themselves with the teeth; on land they do not go by open paths, but break through the thick undergrowth of the woods by their powerful and wedge-like head, in this way escaping the larger carnivora; they have an acute sense of hearing and of sight, and are strong and tenacious of life; their flesh is eaten both in South America and Asia. The best known species is the American tapir (*T. Americanus*, Cuv.), about 6 ft. long and 3½ ft. high, of a uniform brown color, tinged with gray on the head and chest. It is found over almost the whole extent of South America east of the Andes, and its herds sometimes do great mischief by trampling down cultivated fields; it has only one young at a birth, in November. The Asiatic tapir (*T. Malayanus*, Horsf.) is 7 or 8 ft. long, with the hind parts of the body white, and the anterior and the legs black; the trunk is 7 or 8 in. long, the eyes very small, and the rounded ears bordered with white; though the largest, it is the gentlest of the genus. Fossil species are found in the tertiary formations of central Europe.

**TAPPAN, Henry Philip,** an American clergyman, born at Rhinebeck, N. Y., April 23, 1805. He graduated at Union college in 1825, studied at the Auburn theological seminary, was for a year assistant pastor of the Reformed Dutch church in Schenectady, and in 1828 was settled as pastor of a Congregational church at Pittsfield, Mass. In 1832 he was appointed professor of moral and intellectual philosophy in the university of the city of New York. In 1838 the faculty resigned, and for some years he conducted a private seminary. In 1852 he was elected president of the university of Michigan, which post he held till 1863, since which time he has resided chiefly in Europe. His principal works are: "Review of Edwards's Inquiry into the Freedom of the Will" (12mo, New York, 1839); "The Doctrine of the Will determined by an Appeal to Consciousness" (1840); "The Doctrine of the Will applied to Moral Agency and Responsibility" (1841); "Elements of Logic, together with an introductory Review of Philosophy in general, and a preliminary View of the Reason" (12mo, 1844; revised and enlarged ed., 1856); "Treatise on University Education" (1851); and "A Step from the New World to the Old" (2 vols. 12mo, 1852). His three works on the will were republished in Glasgow (1 vol., 1857).

**TAR,** a thick, black, viscid, impure turpentine, procured by burning the wood of *pinus palustris*, *P. sylvestris*, and other species of pine and coniferous trees; also obtained as a product of the destructive distillation of peat, bituminous coals, and shales. It was known to the ancient Greeks, and Dr. Clarke, who describes the method of manufacturing it in the forests of Bothnia, says there is not the smallest difference between the processes there practised and those of ancient Greece. Along the whole coast of the gulf of Bothnia the inhabitants are very generally engaged in this occupation. They make use of the roots of the fir trees, with logs and billets of the same, which they arrange in a conical stack, fitted to a cavity in the ground, generally in the side of a bank. In the bottom of this cavity is placed a cast-iron pan from which a spout leads out through the bank. The heap is covered over with turf, and is then fired, as in making charcoal. Tar collects in the latter part of the process of charring, and runs off through the spout into barrels. Tar is a product where charcoal is the chief object of the process, but is seldom obtained in quantities sufficient to render it an object to collect it, except in charring the resinous woods of the pine family. In Sweden, where the business is also important, some peculiar methods are adopted to increase the yield of tar. Trees of no value for the saw mill are partially peeled of their bark a fathom or two up from the ground, not enough to kill them, but only to check their growth. After five or six years, when cut down, the wood is found to be much richer in resinous matters which produce tar. It is noticed that the condition of the weather during the process of charring may make a difference of 15 or 20 per cent. in the yield of tar. In the United States tar is produced in almost all parts of the country where pitch pine and the *pinus australis* are found. Along the coast of the southern states, especially of North Carolina, Virginia, and Georgia, the business is carried on upon a large scale in connection with the manufacture of turpentine, rosin, and pitch. Old trees which have ceased to produce turpentine, and dead wood which is rich in resinous matter, are selected for the coal pits. The process does not materially differ from that already described. The product is not only sufficient for home consumption, but large quantities are annually exported.—In the preparation of pyroligneous acid, tar is one of the products of the destructive distillation, settling in the bottom of the tanks in which the liquids are collected. The variety known as coal tar is obtained when bituminous matters are distilled for the production of illuminating gas. (See GAS, and PETROLEUM.) Both wood and coal tars are complex mixtures of a variety of liquids holding solid matters in solution or suspension; thus, wood tar contains the hydrocarbons included in the term eupion, and the benzole series of hydrocarbons, including toluole, xylole, cymole, also naphthaline, &c., besides oxidized compounds, including creosote, picamar, kapnomor, &c. Rosin and paraffine are among its solid contents. When its volatile products have been driven off by distillation or boiling, the black carbonaceous residue is known as pitch. The composition of coal tar is materially different, as it contains all the great variety of products derived from the destructive distillation of bituminous coal as obtained from the gas works. Coal tar, a refuse product of these works, may be considered in

general as consisting of from 3 to 15 per cent. of light oils, from 60 to 67 per cent. of heavy oils, usually termed "dead oil," and from 18 to 35 per cent. of pitch; the best coals, as the cannel and boghead, produce tar richer in light oils, and yield least pitch.—Wood tar is thick and hard in cold weather, and softens when warm so as to flow like thick molasses. Its specific gravity is about 1·04. It is boiled down to produce pitch, is used to coat the bottoms of vessels to render them water-tight, and to cover rigging of ships to preserve it from the action of the weather, and is a useful lubricant for the journals of wheels. In medicine it is used internally in chronic catarrhs, and in some cutaneous diseases, as ichthyosis. The inhalation of its vapor is recommended in cases of bronchial disease, the air of a room being impregnated with it by moderately heating the tar placed in a cup over a lamp. It has been found beneficial as an external application to ulcers and various diseases of the skin. It is administered in pills mixed with flour, or in an electuary of tar and sugar. It yields a portion of its properties to water with which it is stirred, and this preparation, known as tar water, is administered as a stimulant and diuretic, and is applied as a wash in chronic cutaneous affections.—Coal tar has an exceedingly repulsive odor, and was long considered of no value; but it has been found that the light oils obtained by its distillation may be made to furnish a variety of singular products, possessing rare properties, and affording the rich colors applicable to dyeing, known as the aniline colors (see ANILINE, BENZOLE, and MAUVE), and also flavors of various essences and agreeable perfumes. The dead oil is frequently burned for the production of lampblack. One of its most useful products is carbolic acid. (See CARBOLIC ACID.) Coal tar is now in common use as a coating for iron work exposed to the weather, and is used with asphalt and other substances to form a tight covering for roofs and the walls of vaults, &c. Its use in preparing a fuel with the dust of mineral coal is noticed in FUEL, vol. vii., p. 518.

**TAR**, a river of North Carolina, which rises in Person co. and flows S. E., passing Tarborough, Greenville, and Washington, and discharges into Pamlico sound by an estuary called Pamlico river. Its length is 140 m., or including Pamlico river 180 m., and it is navigable for small steamers to Tarborough, 85 m. from the sound.

**TARANTO** (anc. *Tarentum*), a city of S. Italy, in the province of Lecce, in Apulia, 44 m. W. S. W. of Brindisi; pop. in 1872, 27,546. It stands on an island at the N. end of the gulf of Taranto, and is connected with the mainland by two bridges. The inner harbor (*mare piccolo*), 12 m. in circumference, is useless as a roadstead, and ships must anchor in the outer harbor (*mare grande*), which is much exposed. The castle and fortifications, built by Charles V., command both harbors. Taranto is the seat of an archbishop, and has a cathedral dedicated to St. Cataldus, an Irishman and the first bishop of Tarentum, about 166. Linen and cotton stockings are made here, and gloves from the byssus of the mollusk *pinna marina*.—Tarentum was colonized by exiles from Sparta in 708 B. C. Its harbor was then the best on the coast. It became a large and powerful city, and 14 other towns were subject to it. It carried on long contests with the Messapians and Peucetians; and about 474 its army suffered a disastrous defeat from the former, in which so many of its nobles were killed that its government, previously an aristocracy, was thereafter democratic. It was predominant in the league of the Greek cities of Italy against Dionysius of Syracuse and the Lucanians. Rome declared war against it in 281. The Tarentines called in Pyrrhus, king of Epirus, after whose defeat and withdrawal from Italy the city surrendered to the consul Papirius in 272, while a Carthaginian fleet was approaching to its relief, and thereafter continued subject to Rome. During the second Punic war the citizens betrayed it into the hands of Hannibal, who held it for more than two years, but was unable to dislodge the Roman garrison from the citadel. In 209 Fabius Maximus retook the city and gave it up to plunder, after putting the Carthaginians to the sword. It continued to be the chief town of S. Italy under the empire. The present town occupies only the site of the ancient citadel, which was originally a promontory, but was made an island by Ferdinand I. of Naples.

**TARANTO, Duke of.** See MACDONALD.

**TARANTULA**, or **Tarentula**, a terrestrial hunting or wolf spider of S. Europe, belonging to the genus *lycosa*, the *L. tarentula* (Latr.). It is the largest of European spiders, measuring 1½ to 2 in. in the length of the body; the color is ashy brown above, marked with gray on the thorax, and with triangular spots and curved streaks of black bordered with white on the abdomen; below saffron-colored, with a transverse black band. It received its popular name from being common in the vicinity of Taranto in S. Italy. It makes no web, wandering for prey, which it runs down with great swiftness, and hiding in holes in the ground and crevices lined with its silk; it has one spiracle on each side, one pulmonary sac, and eight eyes. Its bite was once considered highly poisonous, producing the nervous febrile condition called tarantism, which was supposed to be curable only by dancing to lively music until the person fell exhausted.—The *L. Carolinensis* (Bosc) is called tarantula in the southern states; it attains a length of 2 in. with an extent of legs of 4 in.; it is mouse-colored above, with white sides and whitish dots and lines on the abdomen; below blackish; legs whitish tipped with black. It makes deep excavations in the ground, which it lines with silk; the females carry their young on the back. Its poison is active, and might cause troublesome symptoms in man

if the fangs could be opened at an angle proper to pierce his skin. The great hairy spiders of the genus *mygale* are called tarantulas in the southwestern states, and are destroyed by the large red-winged wasp, *pompilus formosus*.

**TARARE,** a town of France, in the department of the Rhône, on the Tardine, 21 m. N. W. of Lyons; pop. in 1872, 13,694. It is situated at the foot of Mount Tarare, and is celebrated for its muslin manufactures.

**TARASCON** (anc. *Tarasco*), a town of France, in the department of Bouches-du-Rhône, on the left bank of the Rhône, 10 m. N. of Arles and 50 m. N. W. of Marseilles; pop. in 1872, 12,454. It is connected with Beaucaire, on the opposite side of the river, by one of the finest suspension bridges in France. It contains a magnificent castle of the counts of Provence, on a rock overhanging the river, built in the 15th century on the site of a temple of Jupiter, and now used as a prison. The church of St. Martha is a Gothic edifice commenced in the 15th century, with a richly sculptured entrance and a crypt with remarkable tombs and a marble statue of St. Martha. Silk, woollen, and cotton goods are manufactured.

**TARBES,** a town of France, capital of the department of Hautes-Pyrénées, beautifully situated on the left bank of the Adour, 23 m. E. S. E. of Pau; pop. in 1872, 16,565. It is the seat of a bishopric dating from about A. D. 400, and has a modern cathedral built on the site of the castle of Bigorre. It was injured during the middle ages by successive invaders, and was twice burned by the Huguenots in the 16th century.

**TARDIGRADES.** See SLOTH.

**TARE.** See VETCH.

**TARENTUM.** See TARANTO.

**TARGUMS** (Chal. *targem*, to translate), the general name given to the Chaldee, or more accurately Aramaic versions and paraphrases of the Hebrew Scriptures. On account of the many vicissitudes of the Jewish people in the course of their history, and more especially on account of their long captivity in the Babylonian empire, the knowledge of the ancient Hebrew language had gradually declined, and Aramaic had become the language of the people. Hence after the time of Ezra, whenever the Scriptures were read in public by the priest, an interpreter (*meturgeman*) translated them into the Aramaic. This translation it was forbidden to reduce to writing; but the rule was gradually violated, and by the end of the 2d century A. D. the practice of writing translations or "targums" had become fixed. The work of collecting and comparing the versions of individual translators, and reducing them to one, was probably accomplished about the end of the 3d century. The oldest and best of the targums is on the Pentateuch, usually called the "Targum of Onkelos," or "of Onkelos the proselyte." The existence of Onkelos, and his name, have been fruitful themes of discussion among Biblical scholars, but it is now pretty generally agreed that he had nothing whatever to do with the targum attributed to him. Its language is Chaldee, very similar to that of the book of Daniel, and as faithful to the original as its destination as a version for the people would permit. A principal feature is its careful avoidance of all anthropomorphic expressions. Its final redaction probably took place about A. D. 300, and in Babylonia. The targum second in time and importance is that called the "Targum of Jonathan ben Uzziel," or "Targum on the Prophets," embracing Joshua, Judges, Samuel, Kings, Isaiah, Jeremiah, Ezekiel, and the twelve minor prophets. It probably originated in Palestine, and was completed in Babylon about the middle of the 4th century. There is no evidence that Jonathan ben Uzziel ever had anything to do with it, and it was undoubtedly the work of many hands. The third and fourth targums are essentially one work. The former, embracing the whole Pentateuch, is the later, and is called like the second the "Targum of Jonathan ben Uzziel;" but as he could not possibly have had any connection with it, it is often called the "Targum of Pseudo-Jonathan." The fourth, called "Targum of Jerusalem," a name originally common to both this and the third, embraces portions of each of the books of the Pentateuch. The "Targum of Pseudo-Jonathan" is an emended and completed edition of the "Targum of Jerusalem," the latter being itself a collection of emendations, amplifications, &c., to the Targum of Onkelos. They originated in Syria or Palestine in the latter half of the 7th century. The fifth class of targums are on the Hagiographa, and are usually called "Targums of Joseph the Blind," who had undoubtedly been dead many centuries when they were written. They probably originated in Syria some time between the 9th and 12th centuries. They embrace: 1. Proverbs, Job, and Psalms. The targum of Proverbs is both faithful and complete; those of Job and the Psalms are mere collections of fragments. 2. Targums on the Song of Songs, Ruth, Lamentations, Esther, and Ecclesiastes. They appear to be all by one author, but their differences from the originals are so great that they can hardly be called versions. Their dialect is about equally related to East and West Aramæan. 3. Two targums on Esther. One of these, known as the second targum, is for the most part a collection of tales and legends. The sixth targum is on Chronicles, and appears to have been made in Palestine at a very late period. The seventh targum, according to the enumeration of Deutsch, is on Daniel, has been known only within the last 30 years, and exists so far as known only in a translation of a portion of it into Persian. It is not usually included in the list of targums. The eighth targum is on the apocryphal portions of Esther, and has no particular value. Many fragments of lost targums are scattered in va-

rious works of Semitic literature. There is no edition of any of the targums which deserves to be called critical. Most of them are included in the large polyglot editions of the Bible, and a much improved edition of the "Targum of Onkelos" was published at Wilna in 1852. —For an extended discussion of the targums, condensing almost all the learning of the subject, see E. Deutsch's "Literary Remains" (New York, 1874).

**TARIFA,** a town of Spain, in the province of Cadiz, Andalusia, on the southernmost point of the kingdom, in lat. 36° 3′ N., lon. 5° 35′ W., 52 m. S. E. of Cadiz, and 25 m. S. E. of Cape Trafalgar; pop. about 12,000. It is surrounded by old walls and towers, and has a strong fortress. A Moorish castle within the walls is now used as a prison. Tarifa was named from Tarif ibn Malek, a Saracen chief who landed here from Africa in 710, a year before the great Moorish invasion of Spain. During the Moorish domination all vessels passing through the straits of Gibraltar were here compelled to pay duties; whence the word tariff. In 1292 Sancho the Brave of Castile captured it, and Alonso Perez de Guzman held it against the Moors in 1294. About 1340 the Moors besieged it again, but were driven away by the kings of Castile and Portugal. In 1811 it was garrisoned by 1,200 British troops and 600 Spaniards, who held it from Dec. 19 to Jan. 4, 1812, against 13,000 French troops. The French captured the place in 1823.

**TARLETON, Bannastre,** an English soldier, born in Liverpool, Aug. 21, 1754, died Jan. 23, 1833. He was a lieutenant colonel in Cornwallis's army, and raised in this country a troop called the British legion, which contributed largely to British successes in the south. He massacred Col. Buford's regiment, stationed on Waxhaw creek, May 29, 1780, and "Tarleton's quarter" became a synonyme for cruelty. In 1781, with 1,100 men, he attacked an inferior American force near the Cowpens under Gen. Morgan, and was defeated. He was with Cornwallis during the rest of the war, and was present at the surrender of Yorktown. After his return to England he was promoted to the rank of colonel, and was so popular that in 1790 he was sent to parliament free of expense from his native town. In 1817 he received the commission of major general. He was created a baronet, Nov. 6, 1818. He published a "History of the Campaigns of 1780 and 1781 in the Southern Provinces of North America" (4to, London, 1787).

**TARN,** a S. department of France, in Languedoc, bordering on the departments of Aveyron, Hérault, Aude, Haute-Garonne, and Tarn-et-Garonne; area, 2,217 sq. m.; pop. in 1872, 352,718. The S. E. part is mountainous, and the rest of the department is traversed by hills. The principal river is the Tarn, a tributary of the Garonne, which receives the Aveyron, Tescou, and Agout; and near Albi there is a series of falls called Saut-du-Tarn. Coal, iron, lead, copper, gypsum, and porcelain and potters' clay are found. The vine is cultivated, and much brandy is made. Woollen, cotton, and silk goods, iron, leather, and paper are manufactured. It is divided into the arrondissements of Albi, Gaillac, Castres, and Lavaur. Capital, Albi.

**TARN-ET-GARONNE,** a S. department of France, in Guienne, bordering on the departments of Lot, Aveyron, Tarn, Haute-Garonne, Gers, and Lot-et-Garonne; area, 1,436 sq. m.; pop. in 1872, 221,610. The whole department belongs to the basin of the Garonne, and the surface has a gradual slope to the west. The Garonne, Tarn, and Aveyron are all navigable in this department. Iron, coal, and marble are found. About two thirds of the surface is arable, one tenth is forest, and one tenth is devoted to the vine, the wine being excellent. The mulberry for rearing silkworms is extensively cultivated. Mules and poultry are reared in great numbers and are a principal source of wealth. The minerals include iron and some coal and marble. Woollen, linen, and silk goods, cutlery, iron, and beet sugar are manufactured. The department is divided into the arrondissements of Montauban, Moissac, and Castelsarrasin. Capital, Montauban.

**TARPEIA,** a Roman maiden, the daughter of Spurius Tarpeius, who, according to the legendary history of the period, was governor of the citadel on the Capitoline hill when the Sabines invested Rome. Tarpeia saw and admired the bracelets of the Sabines, and offered to betray the citadel to them for "what they wore on their left arms." She opened the gate at night, and as they passed in they threw upon her their shields, which were worn on the left arm, and crushed her. She was buried on that part of the hill called the Tarpeian rock.

**TARQUIN. I. Lucius Tarquinius Priscus** ("the Elder"), fifth king of Rome, assassinated about 578 B. C. According to the common story, his father was a Corinthian nobleman named Demaratus, of the family of the Bacchiadæ, who fled on the overthrow of his order by Cypselus and settled at Tarquinii in Etruria. The son, whose original name was Lucumo, inherited great wealth, married a noble Etruscan woman named Tanaquil, who was skilled in augury, and at her instigation removed to Rome to seek a higher career than any within his reach in Etruria. He gained the confidence of King Ancus Marcius, became guardian to his children, and on the king's death was elected to the vacant throne, about 616. He destroyed the Sabine town of Apiolæ, and subdued a number of Latin towns. His greatest exploit was the defeat of the Sabines, who advanced to the gates of Rome, but were driven back and at length completely overthrown upon the Anio. He built the vast sewers which drained the lower part of the city, and are still perfect; laid out the Circus Maximus, and instituted the Roman games; assigned the shops in

the forum to private citizens; and began to surround the city with a stone wall, which his successor finished. Under Tarquin 100 new members (the *patres minorum gentium*) were added to the senate, and the number of the vestal virgins was increased from four to six. The sons of Ancus Marcius, fearing that he would secure the succession to his son-in-law Servius Tullius, planned his death. (See SERVIUS TULLIUS.) **II. Lucius Tarquinius Superbus** ("the Proud"), the seventh and last king of Rome, son of the preceding, died about 495 B. C. About 534 he formed a conspiracy, murdered Servius Tullius, and usurped the throne. He immediately, as the semi-legendary story of his reign has it, abolished all the privileges that Servius had given to the plebeians, decreed the death of the senators who had supported them, took the whole administration of justice into his own hands, and put to death or exiled all who were obnoxious to him. The senate was seldom consulted, and its vacancies were not filled. Under him the Latin league was joined by the Hernici and by two Volscian towns, and Rome became the head of the confederacy. With the spoils from the wealthy city of Suessa Pometia he began the erection of the capitol. He subdued Gabii, a Latin city which refused to enter into the league, and about 510 besieged Ardea. While Tarquinius Collatinus, son of Aruns, the brother of Tarquinius Priscus, was with the army before this city, his cousin Sextus Tarquinius, the king's son, went to his house at Collatia, and there violated his wife Lucretia. Lucretia sent to the camp at Ardea, and summoned thence her father and her husband. With them came Lucius Brutus. To these three she told what had happened, enjoined them to avenge her, and stabbed herself with a dagger. Brutus led the way into the market place, whither the corpse was carried, summoned the people, and related the occurrence. So great was the hatred already entertained of the Tarquins and the indignation now excited, that a decree was immediately passed by which the king was deposed, and his family banished from the city. Tarquin hastened to Rome, but found the gates closed against him. Brutus repaired to Ardea, where he was received with joy, and the army renounced its allegiance to the tyrant. Tarquin took refuge at Tarquinii, and thence sent ambassadors to Rome to demand his private property. These ambassadors conspired with some young nobles for the restoration of the king, but were discovered, and with their confederates—among them two sons of Brutus—were executed, and Tarquin's private property was given up to plunder. He now formed an alliance with the Etruscan cities of Tarquinii and Veii, and endeavored to recover the throne by force, but was defeated near the forest of Arsia. He next obtained the assistance of Lars Porsena of Clusium, who marched against Rome with a great army. (See PORSENA.) Finally the whole Latin confederacy espoused the cause of Tarquin against Rome, and the contest was decided by the Roman victory in the battle of Lake Regillus, about 498. Tarquin retired to Cumæ, and there died.

**TARRAGON** (Lat. *dracunculus;* Span. *taragona*), an aromatic herb (*artemisia dracunculus*) belonging to the *compositæ*, and in the same genus with the common wormwood, but differing from this and most other species in having undivided leaves. It is a native of Siberia and the region of the Caspian sea, and is much cultivated in European, and sparingly in American gardens. It is a perennial, with stems 2 to 3 ft. high, and bears upon the upper branches small heads of inconspicuous flowers, which in cultivation are infertile; the long, narrow, and smooth leaves have an aromatic odor and a taste somewhat like that of anise. The French, who call it *estragon*, consider the leaves or young shoots essential to the proper dressing of some salads, and use it also to flavor vinegar, pickles, and mustard, and in other compounds. Tarragon vinegar is made by simply infusing the leaves in strong vinegar. The plant is perfectly hardy in this country.

**TARRAGONA. I.** A N. E. province of Spain, in Catalonia, bordering on the Mediterranean and the provinces of Lérida, Barcelona, Castellon, Teruel, and Saragossa; area, 2,451 sq. m.; pop. in 1870, 350,395. The province is traversed from N. to S. by the Prades mountain range, which has numerous offsets that extend to the coast, and the intervening valleys are very fertile. The only river of importance is the Ebro. There are mines of lead, copper, silver, and manganese, and the hills are covered with pine, cork, and oak. Good wine is produced, and there are many manufactories of silk, woollen, velvet, and cotton goods, oil, soap, pottery, and brandy. **II.** A city (anc. *Tarraco*), capital of the province, on the Mediterranean, at the mouth of the Francoli, 273 m. E. N. E. of Madrid; pop. about 18,000. It is fortified, and consists of two parts, the high and the low. It is the seat of an archbishop. There are schools of navigation and design, and an ecclesiastical seminary. The mole, begun in 1790 and finished in 1874, is 4,242 ft. long. The exports to the United States for the year ending Sept. 30, 1874, chiefly wine, nuts, and liquorice, amounted to $286,212.—The town is supposed to have been originally settled by the Phœnicians. Under the Romans it was the capital of Hispania Tarraconensis, and is said to have contained 1,000,000 inhabitants. There are remains of a Roman amphitheatre and aqueduct. It was captured by the Goths, was destroyed by the Moors under Tarik, and remained uninhabited for four centuries. It was captured by the British in the war of succession. In 1811 the French under Suchet took it by storm. In the middle ages a number of church councils were held in Tarragona.

**TARRANT**, a N. W. county of Texas, intersected by the West fork of Trinity river; area,

900 sq. m.; pop. in 1870, 5,788, of whom 705 were colored. The surface is undulating, partly timbered and partly prairie, and the soil fertile. The chief productions in 1870 were 29,587 bushels of wheat, 203,595 of Indian corn, 72,635 of oats, 12,995 of sweet potatoes, 41,669 lbs. of butter, and 728 bales of cotton. There were 6,953 horses, 4,099 milch cows, 14,946 other cattle, 4,205 sheep, and 13,052 swine. Capital, Fort Worth.

**TARRYTOWN,** a village in the town of Greenburgh, Westchester co., New York, on the E. bank of the Hudson river where it widens into the Tappan Zee, and on the Hudson River railroad, 26 m. N. of New York city; pop. in 1875, 6,500. It is very picturesque, and contains a large number of elegant country seats. It is celebrated as the scene of the capture of Major André in 1780, and contains a monument commemorative of that event. South of the village is Sunnyside, the residence of Washington Irving, whose grave is in the Sleepy Hollow cemetery, near the old Dutch church. The village contains a silk factory, a boot and shoe factory, a steam pump factory, a tool factory, a sash and blind factory, a national bank, a savings bank, several public schools, two female seminaries, two boarding schools for boys, a weekly newspaper, and 11 churches.

**TARSHISH,** the name of an ancient emporium, or, according to some critics, more than one, as some of the passages of Scripture in which it is mentioned appear to indicate that it was W. and others E. of Palestine. There are 25 or 30 references to it in the Scriptures. Tartessus in Spain, Tarsus in Cilicia, the island of Thasos in the Grecian archipelago, Carthage, some seaport of the British isles, and Point de Galle in Ceylon have all been urged as fulfilling certain conditions of the Scriptural references. The following facts concerning it are gleaned from various passages of Scripture. It was largely engaged in commerce, and probably in ship building; it is several times spoken of as an island or seacoast; it had large traffic with Tyre and Sidon, especially in gold and silver, tin, iron, and lead; it is usually represented as W. of Palestine and of Tyre, and its ships are spoken of as broken by an E. wind. Yet we are told distinctly in 2 Chron. ix. 21, that Solomon's ships went to Tarshish with the servants of Hiram, returning every three years, and bringing "gold and silver, ivory, and apes, and peacocks;" and that Jehoshaphat joined with Ahaziah in building ships at Ezion-geber, a place on the Elanitic gulf of the Red sea, to go to Tarshish (2 Chron. xx. 36), while the corresponding passages in 1 Kings (ix. 26–28, x. 22, xxii. 48) say that Tarshish vessels were built at Ezion-geber and sent to Ophir, whence they brought "gold and silver," &c. This apparent discrepancy has been explained in three ways: 1 (which is most plausible), that the name "ships of Tarshish" does not necessarily imply that the ships were built at Tarshish or intended to ply between that and some other port, but designated a peculiar style of ships, and that hence ships intended for a long coast voyage were called "ships of Tarshish" from their resemblance to the Phœnician model; 2, that the ships built at Ezion-geber were really intended for the trade to Tarshish (Tartessus) in Spain, and were to be transported across the isthmus of Suez to the Mediterranean; and 3, that there were two and possibly more places called Tarshish.

**TARSUS,** a city of Asiatic Turkey, in the vilayet and 20 m. W. S. W. of the city of Adana, on the right bank of the Cydnus, about 10 m. from the Mediterranean; pop. about 8,000. It stands in a fertile plain, and is well built of stone. It has an ancient church, several mosques, handsome caravansaries, and public baths. Wheat, barley, cotton, copper, and gall nuts are exported.—Tarsus is said by the ancients to have been founded by Sardanapalus. It was taken by Alexander, and under the Romans rivalled Athens, Antioch, and Alexandria. It was the birthplace of the apostle Paul and of several Greek philosophers, poets, and grammarians.

**TARTAR** (named from Tartarus, the infernal regions, according to Paracelsus, on account of its fiery heat; also called argol), the crude bitartrate of potash, precipitated from wines as they ferment, being set free as alcohol is produced, in which it is insoluble. When purified it is known as cream of tartar or bitartrate of potassium. Salt of tartar is a name often given to pure carbonate of potash. Soluble tartar is a name given to the normal or neutral tartrate of potassium, used in medicine as a cooling purgative. (See POTASSIUM, vol. xiii., p. 763.)—Tartar is also the name of an incrustation upon the teeth, composed, according to Berzelius, of salivary mucus 13·5, animal matter soluble in muriatic acid 7·5, and phosphate of lime (earthy phosphates) 7·9.

**TARTAR, Cream of.** See CREAM OF TARTAR.

**TARTAR EMETIC,** a double tartrate of antimony and potassium. (See ANTIMONY.)

**TARTARIC ACID,** an organic tetratomic acid, which is now regarded as belonging to a group derived from corresponding tetratomic alcohols by the substitution of oxygen for hydrogen molecules. Only one of the acids, the erythric ($C_4H_8O_5$), has been actually formed, from erythrite ($C_4H_{10}O_4$), but the composition and behavior of tartaric acid favors the theory that it has a similar derivation. The formula of tartaric acid is $C_4H_6O_6$, and includes four bibasic acids having different crystalline forms, and different properties in regard to polarized light, viz.: dextrotartaric acid, which turns the plane of polarization to the right; lævotartaric acid, which turns it to the left with equal force; paratartaric or racemic acid, which has no rotatory power, but is separable into two equal parts of right-handed and left-handed acids; and an inactive acid not thus separable.

Dextrotartaric acid is the ordinary tartaric acid found in grapes, tamarinds, pineapples, and several other fruits, usually in combination with potassium, and frequently with a small portion of calcium. The acid of commerce is prepared from tartar or argol, and was first separated from it by Scheele in 1770. The present mode of manufacture is as follows. The crude tartar is dissolved in hot water in which is stirred a little pipe clay and bone black to remove coloring matter. The filtered or decanted liquid deposits on cooling crystals of cream of tartar, from which the acid may be prepared by dissolving them in boiling water, or the original solution may be employed. Powdered chalk is added as long as there is effervescence or the liquid reddens litmus. The product consists of an insoluble tartrate of calcium and a soluble normal tartrate of potassium, which latter, after separation of the calcium salt, is mixed with an excess of chloride of potassium, which throws down the remaining tartaric acid also as tartrate of calcium. Both precipitates are washed and digested with sulphuric acid diluted with eight or ten parts of water, by which means sulphate of lime is precipitated while the tartaric acid is left free in the solution. The filtrate is carefully evaporated to the consistency of a sirup, and placed in a warm situation to crystallize. Liebig found that tartaric acid is produced by the action of nitric acid upon milk sugar. It may also be obtained from succinic acid by submitting the latter to the action of bromine and treating one of the products, dibromosuccinic acid, with oxide of silver and water. Tartaric acid crystallizes in transparent, oblique rhombic prisms of sp. gr. 1·75, which are inodorous, permanent in the air, and easily soluble in hot and cold water and in alcohol, but insoluble in ether. The aqueous solution soon spoils, becoming covered with a fungoid growth. Tartaric acid is used in calico printing to liberate chlorine from bleaching powder, and in medicine, principally for the preparation of effervescing powders. (See EFFERVESCENCE.)—*Other Varieties of Tartaric Acid.* The grapes cultivated in certain districts of the upper Rhine and in the Vosges contain, besides ordinary tartaric acid, an isomeric acid, called paratartaric or racemic acid, which resembles it in many particulars, but differs much in others; for instance, it is rather less soluble, and has not the power of rotating the plane of a polarized ray of light. Pasteur has made some interesting researches upon the subject, and finds that if racemic acid is united with single bases, a salt is formed whose crystals are all identical; but if it is united with two bases, after the manner of Rochelle salt, and the solution allowed to crystallize slowly, two varieties of crystals are formed, bounded by the same number of faces, inclined to one another at exactly the same angles. They however have certain hemihedral faces which are developed on opposite sides of the two crystals, so that one crystal is like the reflected image of the other, and may be denominated morphologically right-handed and left-handed crystals. If these crystals are selected and separately recrystallized, each variety will produce its own particular form of crystal, and one will have right-handed and the other left-handed rotatory powers on polarized light. The acids obtained from these two varieties of crystals have also corresponding right-handed and left-handed rotatory powers, one being in fact ordinary or dextrotartaric, the other lævotartaric acid. As these two acids have equal rotatory powers in opposite directions, if their solutions are mingled in equal proportions the mixture will have no effect upon polarized light. When concentrated solutions of the two acids are mingled, crystals of racemic acid are deposited with sensible evolution of heat. Both acids also exhibit pyro-electricity, but in opposite directions. Pasteur also found that racemic acid may be artificially produced by the action of heat upon certain compounds of tartaric acid which are capable of resisting a high temperature; for instance, when tartrate of cinchonine is exposed to a temperature of about 338° F. and afterward repeatedly boiled in water and treated with chloride of calcium, racemate of calcium is formed. Left-handed tartaric acid may in like manner be converted into racemic acid. The formation of racemic acid in these reactions is accompanied by the production of a fourth modification, which Pasteur calls inactive acid, having, like racemic, no action on polarized light, but which, unlike racemic, cannot be resolved into right-handed and left-handed acids.

**TARTARS**, a branch of the Mongolian or Turanian division of the human race, principally inhabiting Asia. The name is one of indefinite and indiscriminate application, used with varying comprehensiveness by different writers. In its widest sense it may be regarded as embracing the Altaian group of Mongolians, according to Virchow; that is, all the various tribes and nations inhabiting the table lands of central and northern Asia who are not of Aryan blood, including the Tartars proper, the Kirghiz, the Calmucks, the Mantchoos (sometimes called the Mantchoo Tartars), the Mongols proper, or people of Mongolia (who, however, probably constitute a separate branch), and the Tungusians, who are thought by Huxley to share the physical characteristics of the Esquimaux. In a more restricted application of the word, the Tartars comprise the Turanian inhabitants of Turkistan and the adjacent regions. These are the nomad Kirghiz, who dwell in Khokan and Kashgar, on the Pamir steppe, and in the adjacent valleys; the Uzbecks, who have advanced furthest toward settled civilization and constitute the governing class in Turkistan; the Kiptchaks, a semi-nomadic people living in Khokan, who travel with their flocks

during the grazing season; the Buddhist Calmucks of eastern Turkistan, extending into Dzungaria; the Kazaks, in the region of the Sir Darya; and many smaller tribes. The predatory Turkomans inhabiting the country E. of the Caspian, from the Oxus to the Persian frontier, are of Tartaric origin, although the pure Tartar features are preserved in but few of the tribes, owing to the large admixture of Aryan blood. The characteristic Tartar physiognomy appears most distinctively at the present day among the Kirghiz, who have high cheek bones, noses thick but depressed, narrow eyes, and little or no beard. Almost every grade of variance from this type, however, is met with. In central Asia, the word Turk is used as synonymous with Tartar, merely to indicate Mongolians. According to Col. Yule, the two classes of people whom Marco Polo would identify with Gog and Magog represent the two genera of the Tartar race, namely, the White Tartars, or Turks, and the Black Tartars, or Mongols proper, who formed the bulk of the followers of Genghis Khan. Indeed, the name Mongol (bold), which he is said first to have given to the tribes who followed his standard, has been regarded as directly derived from Magog.—The word Tartar or Tatar (also Ta-ta) appears to be of Chinese origin, and was applied to early invaders of China from the upper Amoor region. They were a warlike and savage race; and possessing vast numbers of horses, they often descended upon the peaceable Chinese, and plundered their villages. Their predatory characteristics came to be so closely associated with their name as to lead to its eventual application to numerous other robber hordes. The Altai mountains appear to have been the centre of the great Mongolian migratory movement which began in the 4th century and lasted until the 10th, extending over the neighboring Asiatic countries, and under Attila far into Europe, where its results may still be traced in the Tartar population of eastern and southern Russia. The vast military expeditions of Genghis Khan and Timour were subsequent movements of a like character. Shamanism was the original faith of the Mongols. This was succeeded by Buddhism, which was abandoned for Lamaism about the end of the 16th century. Sunni Mohammedanism is now professed by the western Tartars generally, both in Asia and Europe.

**TARTARUS**, in the Grecian mythology, a son of Æther and Gæa, and the father of the giants Typhæus and Echidna. In the Iliad Tartarus is a place as far below Hades as heaven is above the earth, and there by later writers the spirits of the wicked are said to be punished. By the later poets also the name is often used synonymously with Hades.

**TARTARY**, a geographical designation now usually limited to Turkistan and the adjoining regions, but formerly of much wider signification, embracing a broad belt stretching across the centre of the Asiatic continent from the Japan and Okhotsk seas on the east to the Caspian on the west, and according to some geographers extending westward into Europe as far as the river Don. Tartary in its most extended sense therefore includes, in Asia, Mantchooria, Mongolia, Dzungaria, East Turkistan or High Tartary, Turkistan proper, including Khokan, Bokhara, and Khiva (formerly known as Independent Tartary), and all the southern part of the Russian possessions in Asia; and in Europe, the greater part of the Russian governments of Orenburg, Astrakhan, and Yekaterinoslav, the Don Cossack territory, and the Crimea, the last of which was formerly called Little Tartary, and also Crim Tartary, from the name of the horde which settled there in the 13th century. The name Tartary, however, is now seldom applied to any region outside of that bounded N. by Siberia, E. by Mantchooria, S. by China proper, Thibet, India, Afghanistan, and Persia, and W. by the Caspian sea.

**TARTINI, Giuseppe**, an Italian violinist, born at Pirano, Istria, in 1692, died in Padua in 1770. He gave up law and theology, acquired unrivalled proficiency as a violinist, eloped with one of his pupils, and lived for two years concealed in the convent of Assisi. There he diligently studied music, and being at length forgiven, came out of the convent the best player in Europe. Among his celebrated pupils were Pagin, La Houssaye, and Pugnani. His most remarkable composition is his *Sonate du diable*, or "Tartini's Dream."

**TARTRATES**, salts formed by the union of tartaric acid with bases. Tartaric acid is dibasic, and forms with monatomic metals acid salts, like bitartrate of potassium, $KHC_4H_4O_6$; normal salts, like normal potassic tartrate (soluble tartar), $K_2C_4H_4O_6$; and double salts, like sodic-potassic tartrate (Rochelle salt), $NaKC_4H_4O_6$. With diatomic metals it forms normal salts, like normal basic tartrate, $BaC_4H_4O_6$, and double salts consisting of a double molecule of the acid in which two atoms of hydrogen are replaced by a diatomic and two atoms by a monatomic metal, like baric-potassic tartrate, $BaC_4H_4O_6,K_2C_4H_4O_6+2H_2O$. With triatomic metals it forms a peculiar class of salts, well illustrated in the case of the antimony salts, as normal antimonious tartrate, $(SbO)_2C_4H_4O_6$; acid antimonious tartrate, $SbO,C_4H_5O_6$; and potassio-antimonious tartrate, tartar emetic, $KSbOC_4H_4O_6$. Many of the tartrates are used in medicine, and several are employed in calico printing and dyeing, as the tartrate of chromium and the tartrate of potassium and tin. The principal medicinal tartrates are the double salts, tartar emetic and Rochelle salt. (See ANTIMONY, and ROCHELLE SALT.) The tartrates of the alkalies are oxidized in the animal system to bicarbonates, so that the administration of tartrate of potassium renders the urine alkaline. The acid alone, on the other hand, is more efficient than the mineral acids in acidifying this excretion.

**TARUDANT,** the chief city of the province of Sus, Morocco, in the valley of the Sus, about 44 m. from the Atlantic coast, and 140 m. S. W. of Morocco; pop. estimated by Rohlfs at 30,000 to 40,000. It lies near the foot of the S. slope of the Atlas, about 4 m. from the right bank of the river Sus. The country around it is highly cultivated, and it is surrounded by gardens and palm groves. The wall, enclosing a large area, much of which is occupied by gardens, is flanked by towers and entered by five gates. The *kasba* or citadel occupies an angle on the E. side. The streets are crooked, narrow, and impracticable during rains. There are three principal mosques and many smaller ones, two prisons, and several fountains. The dwelling houses are mostly of one story. Tarudant is noted for its leather and dye works, and for manufactures of copper, mostly pots and kettles, which are exported as far as Timbuctoo, Kuka, and Kano. It was formerly celebrated for sugar culture, but the plantations no longer exist. The inhabitants are rude and intolerant to Christians.

**TASCHEREAU, Jules Antoine,** a French author, born in Tours, Dec. 19, 1801, died in Paris, Nov. 11, 1874. He was one of the editors of the *National*, and for a short time after the revolution of July, 1830, he was secretary general of the prefect of Paris and a member of the council of state. Subsequently he became one of the editors of *Historiettes de Tallemant des Réaux* (6 vols., 1833–'4), and the founder of the *Revue rétrospective* (20 vols., 1833–'7). From 1838 to 1842 he was a member of the chamber of deputies, and in 1848 he was returned to the constituent and subsequently to the legislative assembly. Early in 1852 he was placed in charge of the catalogue of the national library, of which he published many volumes (1855 *et seq.*), and he was director general of the library from 1858 to 1874. He edited the works of Molière (8 vols., 1823–'4) and Boufflers (2 vols., 1827), and the literary correspondence of Grimm and Diderot (15 vols., 1829–'30), and wrote biographies of Molière (1825) and Corneille (1829; new ed., 1857).

**TASCHEREAU, Elzéar Alexandre,** a Canadian archbishop, born in Quebec in 1818. He studied in the seminary of Quebec, was ordained priest in 1842, and became successively professor of mental philosophy there, director of studies, and superior. In 1856 he received in Rome the degree of doctor in canon law, and was appointed to teach that science in the Laval university. In 1870 he governed the diocese of Quebec as administrator, after the death of Archbishop Baillargeon, and he was consecrated as his successor, March 19, 1871.

**TASHKEND** (anc. *Shash*), a city of Turkistan, formerly included within the boundaries of Khokan, but now under Russian rule, situated in lat. 43° N., lon. 68° 40′ E., near the junction of two small affluents of the Sir Darya or Jaxartes, 150 m. N. W. of the city of Khokan; pop. estimated at 80,000, mostly Mussulmans. It stands in a fertile plain covered with numerous gardens, amid what is described as literally a forest of fruit trees, is enclosed by a high wall of unburned bricks 16 m. in circuit, and is entered by 12 gates. A great part of the town consists of houses surrounded by gardens and vineyards, the walls of which are so close together that only narrow lanes are left between. The houses are principally built of mud, and are about 11,000 in number. The former residence of the khan consists of a castle defended by walls and ditches; and there are more than 300 mosques, 15 bazaars, and numerous colleges and old temples. The principal manufactures are silk and cotton goods, iron, and gunpowder. Commercially, Tashkend is perhaps the most important city in Russian Turkistan. The chief lines of communication from northern Asia concentrate there, and by means of caravans an extensive trade is carried on with all the neighboring countries, including British India. The attempt of the Russian government, however, to establish a great fair at Tashkend, similar to that held at Nizhni Novgorod, has proved a failure.—Tashkend has been celebrated in central Asia from the earliest times for its wealth and as a commercial emporium. It was assaulted and captured by a Russian force under Gen. Tcherniayeff, in the war with Khokan, in June, 1865, and now with the surrounding territory constitutes a separate administrative district of Russian Turkistan.

**TASMAN, Abel Janssen,** a Dutch navigator, born at Hoorn about 1600, died probably on his second voyage to New Guinea and New Holland. In 1642 he was sent by Van Diemen, governor general of the Dutch East India company, to explore the extent of the continent of New Holland. He set sail from Batavia on Aug. 14, and on Nov. 24 discovered the island to which he gave the name of the governor general (now Tasmania). He subsequently discovered New Zealand, the islands of the Three Kings, and the archipelagos of the Friendly and Feejee islands, and returned to Batavia after a voyage of 10 months. On Jan. 29, 1644, he undertook a second voyage along the coasts of New Guinea and New Holland, the details of which are unknown. He published a narrative of his first voyage, which was reprinted with the voyage of Coreal at Amsterdam in 1722.

**TASMANIA** (formerly Van Diemen's Land), a British colony of Australasia, consisting of the island of the same name and several smaller islands, mostly in Bass strait; area, 26,215 sq. m.; pop. in 1870 (by census), 99,328; estimated, Jan. 1, 1874, 104,217. Capital, Hobart Town. The island of Tasmania is situated 120 m. S. E. of Australia, from which it is separated by Bass strait, between lat. 40° 38′ and 43° 38′ S., and lon. 144° 40′ and 148° 30′ E. It is 240 m. long from N. W. to S. E.; its extreme breadth from N. E. to S. W. is 200 m.; area, 24,330 sq. m. The coasts, which present al-

most every variety of scenery, are indented by numerous bays and inlets, and good anchorage is to be found almost everywhere. The principal harbors are: on the W. coast, Port Davey, which is much frequented by whaling vessels, and Macquarie harbor; on the N. coast, Stanley at Circular Head, Emu bay, Port Frederick, Port Dalrymple, and Waterhouse roads, between Anderson and Ringarooma bays; on the E. coast, George, Oyster, Spring, and Fortescue bays; and on the S. E. coast, Port Arthur, Storm bay, Norfolk bay, D'Entrecasteaux channel, Port Esperance, Muscle bay or Southport, and Recherche bay. There are 55 islands off the coast, all of which belong to Tasmania. The Furneaux group, N. E. of the main island, includes Flinders island (801 sq. m.), Cape Barren island (172 sq. m.), Clarke island (30 sq. m.), Chappell, Hummock, and several smaller islands. Their inhabitants, 242 in number in 1870, many of whom are half-breeds, live mostly by seal fishing. Off the N. W. end of Tasmania are King's island (425 sq. m.), Robbins' island (37 sq. m.), Hunter, Three Hummock, and smaller islands. Off the S. E. coast are Bruny island (140 sq. m.), divided into North and South Bruny, which are connected by a narrow isthmus, Maria island (37 sq. m.), Schouten island (10 sq. m.), and many smaller.—Tasmania is traversed by high mountain chains, full of glens and ravines, and separated by fertile and well watered plains. There are two principal chains, one running parallel with the E. coast, the highest peak of which is Ben Lomond, 5,010 ft., and the other forming an elevated table land in the middle of the island, reaching an elevation of 5,096 ft. in Cradle mountain; from the latter diverge numerous smaller ranges, north, west, and south. In the middle of the table land are several lakes, the largest of which are the Great lake (28,000 acres), Sorell (17,000), St. Clair (10,000), and Arthur, Crescent, and Echo (8,000 to 12,000). The chief rivers on the S. E. coast are the Huon, which flows into D'Entrecasteaux channel; the Derwent, which rises in Lake St. Clair, receives numerous tributaries, and flows into Storm bay; and the Coal, which flows into Pitt water. On the S. W. and W. coast are the Spring, the Davey, the Gordon and King's falling into Macquarie harbor, the Pieman, and the Arthur, all with large tributaries; and on the north the Montague, Duck, Detention, Inglis, Cam, Emu, Blythe, Leven, Gawler, Forth, Mersey, Rubicon, Tamar, Piper, Forrester, Trent, and Ringarooma. The Tamar is a tidal river formed by the junction of the North and South Esk.—The central mountain chain, which is of volcanic formation, is of trap upheaved through sandstone, clay, limestone, and slate. The rocks of the E. and S. W. coasts are basalt, granite, gneiss, and quartz. It is conjectured that the island was once connected with Australia, and that the smaller islands in Bass strait are the peaks of a disrupted mountain chain. Tasmania is rich in minerals. Iron abounds near Hobart Town and on the banks of the Tamar river. Large deposits of tin ore were discovered in 1872 at Mt. Bischoff, and small lodes of copper, lead, and bismuth have been found. Coal abounds at Mt. Nicholas and Douglas river in the northeast, on the Mersey river in the north, at Jerusalem N. of Hobart Town, and at Hamilton in the middle of the island. None of these deposits are worked, but mines of bituminous coal are worked near Port Seymour, and of anthracite coal at Port Arthur, New Town, and Port Serrell. The principal gold mines are at Nine Mile Springs, Mathinna, and Hellyer river. Limestone is abundant, and a fine quality of white freestone is largely exported to Melbourne.—The climate is remarkable for mildness, being subject to extremes neither of heat nor cold. The average temperature of the summer months, December, January, and February, is about 62°; of the autumn months, March, April, and May, 55°; of the winter months, June, July, and August, 47°; and of the spring months, September, October, and November, 54°. The mean annual temperature, as ascertained by 30 years' observation, is about 54°. The mean annual rainfall is 22·71 inches. The atmosphere is remarkably pure, and zymotic diseases are rare. Thunder storms are not common and are seldom violent. Many persons, enervated by the hotter climate of Australia, annually visit Hobart Town for health. —Although much of the interior is mountainous and rugged, there are large tracts of pasture land, and extensive forests, chiefly of the eucalyptus and acacia, affording excellent timber for both cabinet work and ship building. The soil is very fertile, and produces abundantly all the cereals, vegetables, and fruits of temperate climates. Among the fruits cultivated are the peach, plum, apricot, cherry, quince, fig, mulberry, gooseberry, strawberry, raspberry, currant, and grape; also the walnut, filbert, and almond. Large quantities of green and preserved fruits are exported. The live stock in 1873 amounted to 22,334 horses, 106,308 horned cattle, 1,490,738 sheep, 59,628 swine, and 2,201 goats. The indigenous animals are mostly marsupials, like those in Australia, and they exist in such numbers that kangaroo leather and opossum furs are articles of export. There is one unique animal, called the thylacine, Tasmanian wolf, or native tiger, the largest carnivorous animal in Australasia, though no larger than a wolf. Whales, both black and spermaceti, are numerous off the coasts, particularly in Bass strait, and the fishery is prosecuted with much vigor; and seals frequent the shores and the islands in their vicinity. Excellent fish are found in all the bays and rivers, and oysters are very abundant. Salmon have been introduced from England, and are now caught in the Derwent. The industries of Tasmania are not extensive. There are several breweries in Hobart Town,

where ale is made for export to the other colonies, the climate being especially adapted to malting and brewing. There are also tanneries, founderies, soap and candle manufactories, jam-boiling and fruit-preserving establishments, and two manufactories of cloth, tweed, blankets, &c. The value of exports in 1873 was £893,556; of imports, £1,107,167. The exports of wool amounted to 4,243,433 lbs., valued at £314,068; of jams to the value of £98,281; and of hops, £41,015. Other articles of export are bark, butter and cheese, bran and pollard, the cereals, flour, skins and leather, horses, sheep, sperm and black oil, fruits and vegetables, gold (in 1873, £15,309), and ale. The most important ports are Hobart Town and Launceston. Frequent communication by steamships is maintained between them and Sydney and Melbourne. The only completed railway is the Launceston and Western, 45 m. long, connecting Launceston and Deloraine. The line was opened in 1871; in 1872 it was taken by the government. The Mersey and Deloraine railway, to connect Deloraine with the mouth of the Mersey river, had 18 m. completed in 1874. A main line, connecting Launceston with Hobart Town, 120 m. long, will probably be opened in 1876. The principal towns are connected by telegraph, of which 291 m. were open in 1873. A submarine cable, laid in 1869, connects Launceston with Melbourne.—The aborigines of Tasmania resembled physically those of Australia, excepting that their hair was wooly. They were estimated to number 3,000 to 4,000 when the island was colonized, and were inoffensive; but from the abuse of the convict colonists a war of extermination broke out. At its close the remnant of the tribe was transported first to Flinders and then to Maria island, and finally in 1849, when only 36 remained, to the vicinity of Hobart Town, where they were established in comfortable dwellings. In 1870 only one, a woman, survived. In 1848 nearly a third of the inhabitants were or had been convicts; and although since the cessation of transportation the proportion has gradually decreased, the moral effect is still felt. With respect to religion, the principal denominations are represented as follows: church of England, 53,047; Roman Catholic, 22,091; church of Scotland, 6,644; Free church of Scotland, 2,420; Wesleyans, 7,187; Independents, 3,931. The whole number of churches and chapels in the colony is 316. The Anglicans and Roman Catholics have each a bishop. Education is under the management of a council, and a board supervises the distribution of all moneys voted by parliament. In 1873 there were 141 public schools, with 10,803 pupils on the rolls and an average attendance of 7,047; 105 male teachers, 108 female teachers, and 32 pupil teachers. There are four superior schools: Horton college, high school, Hutchins's school, and the church grammar school. The attendance of children at the public schools is compulsory, under a fine of £2, except in cases of private education. In 1870 there were 29,444 persons in the colony who were unable to read. The public press includes two daily newspapers published at Hobart Town, two tri-weekly and a semi-weekly at Launceston, and several weekly and monthly periodicals.—The colony is divided into 18 counties, which are subdivided into parishes. For electoral purposes it is divided into districts, 16 for the election of members of the legislative council, and 32 for members of the house of assembly. The government consists of a governor and executive council appointed by the crown. The governor is assisted by a cabinet consisting of four official members, colonial secretary, colonial treasurer, attorney general, and minister of land and works, and sometimes a premier *ex officio*. The legislative power is vested in a parliament of two houses, the legislative council and the house of assembly. The legislative council is composed of 16 members elected for six years, the house of assembly of 32 members elected for five years. The judiciary consists of a chief justice, a puisne judge, and minor justices. The revenue is derived from customs, railway receipts, land sales, and miscellaneous taxes. The general revenue for 1875 was estimated at £295,317, and the expenditure at £311,206. The debt of the colony at the end of 1873 was £1,477,600, incurred mostly for the following purposes: public works, £938,528; immigration, £200,000; commute state aid to religion, £100,000; in payment of an old debt to the imperial government, £30,500; in aid of land fund, £30,000.—Tasmania was discovered in 1642 by the Dutch navigator Abel Janssen Tasman, who believed it to be a part of the mainland of Australia, and who named it Van Diemen's Land after Anthony van Diemen, then governor general of the Dutch East Indies. Its insularity was not established till 1798, when Mr. Bass, a surgeon of the British navy, circumnavigated it. The first settlement was made in 1803 by a detachment of marines and a body of convicts, in charge of Lieut. Bowen, who selected Risdon on the Derwent river as the site for a penal station. In 1804 Col. Collins, who landed with 400 prisoners, changed the site to the opposite side of the river, and named it Hobart Town after Lord Hobart, then secretary of state for the colonies. Van Diemen's Land was erected into an independent colony in 1825. For some years the prosperity of the colony was impaired by the depredations of "bush rangers," or escaped convicts, but they were finally suppressed. In 1853 the transportation of convicts ceased, and on Jan. 4, 1856, on the petition of the legislative council to the home government, the name of the colony was officially changed to Tasmania.

**TASSAERT, Nicolas François Octave**, a French painter, born in Paris, July 26, 1800, died there by his own hand, April 26, 1874. He left the school of fine arts in 1825, and became known

as a distinguished portrait, historical, and genre painter; but long struggles with adversity drove him to suicide. His principal productions include "The Funeral of Dagobert at St. Denis" (for the museum of Versailles), "Death of Correggio," "The Slave Merchant," "Diana at the Bath," and "The Old Musician."

**TASSO, Bernardo,** an Italian poet, born in Bergamo, Nov. 11, 1493, died in Ostiglia in September, 1569. He became in 1531 secretary to the prince of Salerno, and accompanied him in several expeditions of Charles V. In 1539 he settled at Sorrento with his bride, the celebrated Porzia de' Rossi. After her death he fled from the inquisition, became connected with the courts of Urbino and Mantua, and ended his life as governor of Ostiglia. He wrote a heroic poem entitled *L'Amadigi*, founded on the story of Amadis de Gaul, containing 100 cantos. One of the episodes was expanded into a poem called *Floridante*, published after his death by his son. He also wrote sonnets, odes, and lyrics, a "Discourse on Poetry," and "Three Books of Letters."

**TASSO, Torquato,** an Italian poet, son of the preceding, born in Sorrento, March 11, 1544, died in Rome, April 25, 1595. He received his first education at Naples, and studied in Rome, Urbino, Venice, Padua, and Bologna. In 1562 he wrote his charming romantic poem *Rinaldo*, and about the same time began to prepare his epic on the delivery of Jerusalem by Godfrey of Bouillon. In 1565 he went to Ferrara as a gentleman in the suite of Cardinal d'Este, whose brother, the duke Alfonso II., received Tasso with great distinction. His grave and melancholy beauty, eloquence, and varied accomplishments enlisted general admiration, and endeared him to the duke's sisters Lucrezia, the future duchess of Urbino, and Eleonora, who became known as the special object of his adoration. After about a year's residence with the cardinal in Paris, where Charles IX., Catharine de' Medici, and the French poets showed him marked attentions, he became estranged from his patron, and, mainly through the influence of the princesses, was in 1572 formally attached to the court of Ferrara, with a salary but without specific duties. His celebrated pastoral drama *Aminta* was performed in 1573 with great splendor at the court, and afterward at Urbino. In 1575 he completed his great epic poem under the title of *Il Goffredo*, which was afterward changed to *Gerusalemme liberata*. The duke, Eleonora, and Lucrezia (who had separated from her husband) gave him new evidences of their regard, and would hardly permit him to leave them. Yet in November, 1575, he went to Rome to submit his epic to Scipione Gonzaga, and received an invitation to enter the service of the Medici family, which he ultimately declined; but the hostility between the Medici and Estes made him ever afterward believe that the duke had taken umbrage at his negotiation with them, although on his return to Ferrara he was received with the wonted cordiality. He was now living in perpetual fear of his enemies, whose numbers had increased with his fame, and of emissaries of the inquisition, although that tribunal had absolved him from the charge of heresy to which he had long fancied himself liable on account of some passages in the *Gerusalemme*. At length he found his correspondence intercepted, and had a violent altercation with a deceitful friend who had purloined his private papers, with a view, he suspected, of giving the duke evidence of his relations with Eleonora, and he was charged with referring to his love for her in the episode of Sofronia and Olindo in his epic. But the duke expressed no other feeling about him excepting an anxiety for the restoration of his mind, which he regarded, or feigned to regard, as diseased. Even after a murderous assault said to have been committed by Tasso in one of his frantic fits upon Lucrezia's servant, the duke released him after a brief confinement and permitted him to retire to a convent (June, 1577), where he was to remain till the restoration of his health. Tasso, however, fled in July to Sorrento, and reached his sister Cornelia's house in the disguise of a shepherd and in a wretched condition. Having regained his health, he became anxious to return, and at the instance of his friends the cardinals Albano and Gonzaga, the duke permitted him do so on condition of his putting himself under medical treatment. New indignities awaited him at Ferrara (February, 1578), despite the friendly disposition of Eleonora. He failed to recover his manuscripts, and, shunned by everybody, he fled again from city to city, everywhere regarded as a maniac. At the court of Urbino he had a short interval of rest, but his apprehensions of danger drove him to Turin. Here he was befriended by Eleonora's brother the marquis d'Este, and might have lived in peace; but he hastened back to Ferrara in the vain hope that the celebration of the duke's third marriage with a princess of Mantua (early in 1579) would prove auspicious for a reconciliation. He was not permitted to see any member of the ducal family, and the courtiers and lackeys insulted him so grossly that he broke out in vehement denunciations, and was committed to the hospital of Santa Anna. Here he was surrounded by maniacs of the worst description, and treated with a harshness which excited the pity of Montaigne and other visitors. A garbled publication of the *Gerusalemme* in 1580 was followed in 1581 by genuine editions, which had a prodigious circulation, and gave such a prestige to his name that his situation was slightly improved, and many of his admirers availed themselves of the easier access to his cell. The death of Eleonora in 1581, which Lucrezia thought would make the duke relent, had no such effect; and while fortunes were made by the sale of his epic, Tasso lingered in prison. He was not released

until July, 1586, and only after repeated appeals from the most influential quarters and after his health had reached its lowest ebb, and then solely on condition of remaining in charge of Duke William of Mantua, who showed him much kindness. After William's death he made in 1587 ineffectual attempts to better his fortunes in Rome, and in 1588 to recover his patrimony at Naples. For the rest of his life he almost continually travelled from Naples to Rome and from Rome to Naples, enjoying in the latter city his residence at the monastery of Mount Olivet; but he was finally obliged to live in a charitable asylum at Rome until the grand duke of Tuscany came to his rescue and invited him to visit Florence (1590). Here, as everywhere else, he received distinguished though empty honors. In a subsequent journey to Rome, the famous brigand Sciarra refrained from molesting him and his travelling companions, and showed great deference for his genius. In 1593 appeared his *Gerusalemme conquistata*, a remodelled form of his first epic, to which he alone regarded it as superior. It was dedicated to Cardinal Cinzio Aldobrandini, who thereupon induced Pope Clement VIII. to crown Tasso in the capitol. He reached the Vatican on Nov. 10, 1594, but after a relapse of his fever he was taken at his request to the monastery of St. Onofrio, on the Janiculum, where he died before the time assigned for his coronation.—The tribulations of the poet, the peculiar condition of his mind, his relations with the princess Eleonora, and the duke's proceedings against him, have given rise to many conflicting statements, and thrown a pathetic halo over his life and genius. Goethe has made him the hero of a celebrated drama; Hallam regarded him as superior to Virgil in grace, though inferior in vigor; Ranke and other eminent scholars have written on him extensively; Lamartine has called him "the crusader of poetry;" and Friedrich Schlegel places him above Ariosto on account of his melodious versification and picturesque and impassioned delineations of love. The academy della Crusca, however, bitterly contested at the time Tasso's superiority over Ariosto. The most complete of the early genuine editions of the epic appeared at Parma (4to, 1581), and the most correctly printed among the latest editions is that of Padua (3 vols. 24mo, 1827–'8). It has been translated into most Italian dialects and into Latin, repeatedly into English, French, German, Spanish, Portuguese, Polish, and Russian, and in 1875 into modern Greek. The best translation into English is by Edward Fairfax (London, 1600; latest American ed., New York, 1855); and the most recent English version is by Sir J. K. James (2 vols., 1865). The *Gerusalemme* has cast Tasso's other works into the shade, although his *Rime* or lyrical poems are unsurpassed in their descriptions of disappointed love, and the choruses in his otherwise unsuccessful tragedy *Torrismondo* are remarkable for pathetic sweetness. His prose dialogues, moral treatises, and other minor works are also entitled to more attention than they have received. The most complete edition of his works is by Rosini (33 vols., Pisa, 1821–'32). A good select edition appeared at Milan (5 vols., 1823–'5). His principal biographers in Italian are his friend Manso (Naples, 1619) and Serassi, whose work is the most complete (Rome, 1785; new ed., Florence, 1858); and in English, Black (2 vols. 4to, Edinburgh, 1810) and R. Milman (2 vols., London, 1850). See also "Conjectures and Researches concerning the Love, Madness, and Imprisonment of Torquato Tasso," by Richard Henry Wilde (2 vols. 12mo, New York, 1842); *Sulla causa finora ignota delle sventure di Tasso*, by Capponi (2 vols., Florence, 1840–'46); a complete chronological edition of his correspondence, by C. Guasti (5 vols., 1852–'5); and *Degli amore e della prigione di Tasso*, by L. Cibrario (Turin, 1862).

**TASTE**, the sense by which we distinguish the sapid properties of bodies, through the sensory apparatus in the mouth. Though the tongue takes the principal cognizance of gustatory sensations, the soft palate and its arches and the fauces share in this office. The nerves of taste are the lingual branch of the trifacial or fifth pair of cerebral nerves, distributed to the mucous membrane of the anterior two thirds of the tongue, and the glosso-pharyngeal nerve, which supplies the base of the tongue, the soft palate, pillars of the fauces, and upper part of the pharynx. The glosso-pharyngeal nerve is also regarded as the channel by which disagreeable impressions producing nausea and vomiting are propagated to the medulla oblongata. The exact seat of the sense of taste has been determined by placing in contact with various parts of the mucous membrane small sponges moistened with some sweet or bitter fluid, like a solution of sugar or quinine. It is thus found that the power of perceiving savors resides in the whole upper surface (*dorsum*) of the tongue, its point and edges, the soft palate, the fauces, and part of the pharynx. The most acute sensibility to taste is found in the base, tip, and edges of the tongue, while it is less marked in the middle of its upper surface, and almost or entirely wanting in its inferior surface. These parts are also supplied with general sensibility by the same nerves which communicate to them the sense of taste; and in the tip and edges of the tongue the general sensibility is even unusually acute, as compared with the external integument or other mucous membranes. (See TONGUE.)—Owing to the existence of these two kinds of sensibility in the organs of taste, we must distinguish between the different impressions produced upon them by foreign substances. The sapid qualities, properly speaking, which we distinguish by the sense of taste alone, are such as we designate by the terms sweet, sour, alkaline, salt, bitter, &c., besides

various compound savors, like those of cooked meats, vegetables, and fruit. But other physical qualities are often mingled with these, which are of a different character, and are perceived by the general sensibility of the mucous membrane, here developed to an unusual degree. Thus, what is called a viscid, watery, or oleaginous taste is simply a certain modification in consistency of the substance under examination. An oil may have a well marked taste; but this is in consequence of its partial rancidity, or of its containing other impurities or sapid ingredients. An oil which is perfectly pure and fresh is almost or entirely destitute of taste, and conveys to the mucous membrane of the mouth only the sense of its oleaginous consistency. Other substances have an irritating or pungent quality, like alcohol, red pepper, and mustard; and this pungency is also perceived by the general sensibility of the mucous membrane. Most of the condiments in ordinary use produce their effect principally by means of their pungency, mingled with a small proportion of true sapid qualities. Many articles of food also have their taste modified or heightened by the presence of volatile ingredients perceived by the sense of smell; and this mixture of sapid and odoriferous qualities gives to the substances in question the properties which we know as their flavors. In this way are produced the flavors of wines, of tea and coffee, of cooked meats, &c. How much of the effect produced by these substances upon the senses is due to their odoriferous qualities, may be ascertained by holding the nose while swallowing them, so as to prevent the passage of air through the nasal passages.—An essential condition of the sense of taste is, that the sapid substance should be in a state of solution. In the solid form a substance even of well marked sapid quality, like crystallized sugar, produces no effect upon the taste, and is perceived when applied to the tongue only as the physical contact of a foreign body. It is only when it is presented in the liquid form, or is gradually dissolved in the fluids of the mouth, that it impresses the nerves of taste, and its sapid qualities are accordingly perceived. This is probably because sapid substances excite the sense of taste only by being actually absorbed by the mucous membrane, and thus coming in contact with the extremities of the gustatory nerves. This absorption requires time for its accomplishment, and especially requires that the substance, to be taken up by the mucous membrane, should be in a proper condition of fluidity. It is also on this account that a free secretion of saliva is so essential an aid to the sense of taste. When the internal surface of the mouth is in a dry condition, the savor of the food is imperfectly perceived. The salivary fluids, being themselves partly composed of organic materials, are especially adapted for rapid absorption, and, as they penetrate the mass of the food undergoing mastication, they become impregnated with its sapid ingredients, and cause them to penetrate readily the substance of the mucous membrane. The sense of taste is also materially aided by the movements in mastication, and particularly by those of the tongue; since a combination of movement and pressure is always favorable to the absorption of fluids by the animal membranes. The full effect of sapid substances is not obtained until the moment of actual deglutition. It is only after mastication is complete, and the food is actually in the involuntary grasp of the fauces and pharynx, to be swallowed into the stomach, that all parts of the gustatory mucous membrane are brought in contact with it at once, and their sensibility heightened by the simultaneous contraction of the muscles of deglutition.

**TATE**, a N. W. county of Mississippi, formed in 1873 from De Soto and Marshall counties; area, 406 sq. m.; pop. about 12,000. It is drained by Coldwater river, and traversed by the Mississippi and Tennessee railroad. The surface is undulating, and the soil fertile. The chief crops are wheat, Indian corn, sweet potatoes, and cotton. Capital, Senatobia.

**TATE, Nahum**, an English poet, born in Dublin in 1652, died in Southwark, Aug. 12, 1715. He went to London, succeeded Shadwell in 1692 as poet laureate, and died in the precincts of the mint, a privileged place for debtors. He was associated with Dryden in the authorship of "Absalom and Achitophel," the second part of which is mostly his composition. He wrote "Memorials for the Learned, collected out of eminent Authors in History" (1686); "Miscellanea Sacra, or Poems on Divine and Moral Subjects" (1698); and "Panacea, a Poem on Tea" (1700). He also produced an alteration of "King Lear" from Shakespeare, which long held the stage to the exclusion of the original. But he is chiefly remembered by his version of the Psalms, made in conjunction with Brady, which is still retained in the "Book of Common Prayer." It was first published under the title of an "Essay of a New Version of the Psalms of David, consisting of the first Twenty, by N. Brady and N. Tate" (8vo, 1695). This was succeeded by "The Book of Psalms, a New Version in Metre, fitted to the Tunes used in the Churches, by N. Tate and N. Brady" (1696), and a "Supplement of Church Hymns" (1700).

**TATIAN** (Tatianus), an ecclesiastical writer of the 2d century, the time and place of whose birth and death are uncertain, though he calls himself an Assyrian. He had received the education of a Greek, and been a teacher in the pagan schools before he went to Rome, where he practised as a teacher of eloquence, became the associate of Justin Martyr, and was converted to Christianity. After the death of Justin (about 165), he seems to have returned to the East, and adopted views resembling those of the Gnostic Marcion on the dual principle of good and evil, and on the essential depravity of matter. He became the founder

of a sect known as Tatianists, forbade marriage, animal food, and wine, substituted water for wine in the eucharist, and required the giving up of worldly goods as the evidence of Christian sanctity. His "Discourse to the Greeks" (Πρὸς Ἕλληνας), written while he was still orthodox, has passed through many editions, the earliest being that of Zürich in 1546, and the best that of Oxford (8vo, 1700). The account of Tatian and his opinions is best given by Le Nourry in Worth's edition of his works; by the Benedictine Ceillier, in vol. ii. of his *Auteurs sacrés et ecclésiastiques;* and by Daniel in *Tatian der Apologet* (Halle, 1837).

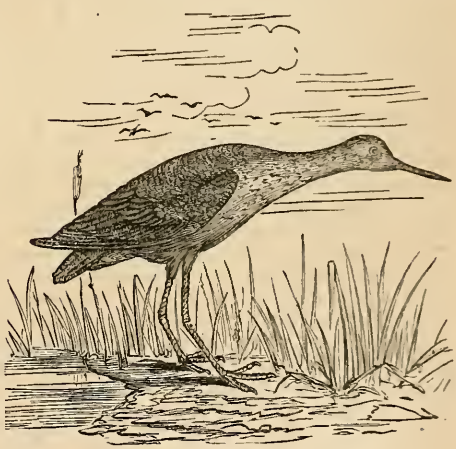
**TATIUS, Achilles.** See ACHILLES TATIUS.

**TATKELEFF, Vogisny.** See p. 905.

**TATNALL,** a S. E. county of Georgia, bounded S. by the Altamaha and N. E. by the Cannouchee, and intersected by the Great Ohoopee river; area, about 1,200 sq. m.; pop. in 1870, 4,860, of whom 1,280 were colored. The surface is level, and the soil sandy and mostly poor. The chief productions in 1870 were 74,684 bushels of Indian corn, 28,117 of oats, 25,386 of sweet potatoes, 314 bales of cotton, 23,834 lbs. of wool, and 120,012 of rice. There were 699 horses, 700 mules and asses, 4,567 milch cows, 15,138 other cattle, 12,030 sheep, and 13,420 swine. Capital, Reidsville.

**TATTA,** a town of British India, in Sinde, on the W. bank of the Indus a few miles above the head of the delta, 48 m. S. S. W. of Hydrabad; pop. about 10,000. It stands on ground slightly elevated by ruins, which are exceedingly abundant in the vicinity, and include an old cemetery said to contain 1,000,000 tombs. The town is much decayed. During the season when the river overflows its banks it is almost completely surrounded by water. There are some manufactures of cotton and silk goods, but the trade is not very extensive. Tatta is supposed to be the ancient Pattala. The Portuguese plundered it in 1555, and the British established a factory there in 1758.

**TATTLER,** the proper name of the wading birds of the snipe family, of the division *totaneæ*, as distinguished from the *tringeæ* or sandpipers; they are often called sandpipers, in England gambets, and in France *chevaliers* or *totanes.* The bill is slender, nearly straight, about as long as the tarsus, pointed, not grooved for the terminal fourth, gape extending beyond the culmen, terminal half hard and horny, and base covered with a soft skin; wings long; legs and neck elongated; toes connected anteriorly by membrane; tail almost always strongly barred. They are genuine waders, frequenting the water's edge, picking up insects, mollusks, &c.; they are swift fliers and runners, and some species take readily to the water; they perform migrations of considerable extent, going north to breed in spring, and returning through the temperate regions in early autumn, at which time the flesh is fat, juicy, and much esteemed. The French name is derived from the body being mounted on long legs, and appearing as if on horseback. The nest is on the ground, usually near water, and the young quit it as soon as hatched; in the breeding season they keep in pairs, and the families remain together until spring.—The tell-tale tattler or greater yellow-legs (*gambetta melanoleuca*, Bonap.) is about 14 in. long, 25 in. in alar extent, with the bill $2\frac{1}{4}$ in.; wings long, first quill the longest; tail short; legs yellow and long; hind toe small. Above it is cinereous of various shades, with lines, spots, and edgings of dull white; lower back brownish black; rump and upper tail coverts white with more or less perfect brownish bands; white below, with brownish stripes on neck and bars of spots on breast; quills brownish black; tail white, with brownish black bands. This bird, sometimes called stone snipe, is found throughout temperate North America and Mexico, preferring large soft marshes and the vicinity of fresh



Tell-Tale Tattler (Gambetta melanoleuca).

water; it lives with other waders and the smaller ducks; the common name is derived from the habit of uttering its shrill whistle of four loud and rapidly repeated notes at the least sign of danger, giving the alarm to all the ducks and other game birds in the neighborhood; its notes are easily imitated, calling the bird within gun-shot; the flesh in autumn is excellent eating; the eggs are four, $2\frac{1}{4}$ by $1\frac{1}{2}$ in., pale greenish yellow, with brown and purplish gray blotches. The common yellow-legs and the willet will be noticed under those titles.—The spotted tattler or peet-weet (*tringoides macularius*, Gray) is $7\frac{1}{2}$ to 8 in. long, 13 in. in alar extent, with the bill 1 in., and the tarsus rather less; the bill has both mandibles grooved and is tapering; lower third of tibiæ naked; tail much rounded; outer toe webbed to first joint. It is brownish olive-green above, with bronzed lustre and lines and spots of brownish black; line over eyes and

under parts white, the latter with circular brownish black spots; primaries, secondaries, and outer tail feathers tipped with white, the last with irregular brownish black bars. It is found over temperate North America, in Central America in winter, and also in Europe; it is one of the most common marsh birds of New England, arriving from the south about the beginning of May; it is often called "teeter" from the jerking of its tail up and down; it does not associate with other species, nor form large flocks; it alights on branches overhanging the water, and on fences and walls; the flesh is delicious in autumn; the eggs are 1¼ by 1 in., grayish yellow with deep brown blotches; both sexes incubate.

**TAUCHNITZ. I. Karl Christoph Traugott**, a German publisher, born at Grosspardau, near Grimma, Oct. 29, 1761, died in Leipsic, Jan. 14, 1836. He learned the printer's trade at Leipsic, and worked in the celebrated printing house of Unger in Berlin. In 1792 he entered the house of Sommer in Leipsic, and in 1796 established in that city the house long known by his name. He began with a small printing house, but in 1798 opened a bookstore in connection with it, and in 1800 a type foundery. In 1809 he published the first volumes of a series of Greek and Latin classics, which, from their accuracy, cheapness, and convenient size, became very popular. He also published some very perfect editions of classical authors in folio. In 1816 he established the first stereotype foundery in Germany; and he was the first to stereotype music. His edition of Mozart's *Don Giovanni* had a wide popularity. He also printed stereotype editions of oriental works, including two of the Hebrew Bible, and an edition of the Koran. **II. Karl Christian Philipp**, son of the preceding, born in Leipsic, March 4, 1798. He enlarged his father's business, and carried it on with success until he retired in 1865. Besides many celebrated and important philological publications, he completed in 1840 Fürst's edition of the Hebrew concordance. **III. Christian Bernhard**, baron, a German publisher, cousin of the preceding, born Aug. 25, 1816. He founded in Leipsic in 1837 a publishing house, which has become celebrated by the issue of a collection of English works, well known as the "Tauchnitz editions," of which more than 1,000 volumes had been published in 1868, of more than 120 English authors; a copyright for the continent being secured for the more recent works. In 1866 he began the publication of a series of German authors for the use of English-speaking people. In 1860 the title of baron was conferred upon him by the duke of Saxe-Coburg-Gotha, and his title was recognized by the king of Saxony in 1861.

**TAULER, Johann**, a German mystic, born probably in Strasburg in 1290, died there, June 16, 1361. At the age of 18 he renounced a fortune to enter the Dominican cloister. After studying the scholastic theology in Paris he returned to Strasburg, and came under the influence of Master Eckhart. He became one of the so-called "friends of God," an unorganized brotherhood, including priests, nobles, and burghers in all the large cities, who represented the height of mysticism, denied the special prerogative of the clergy except in the celebration of the sacraments, and dwelt upon worship in the heart and life. He preached in Strasburg, Cologne, and Basel, where Henry of Nördlingen had resumed his forbidden functions. Amid the ravages of the black death (1348–'9), he bestowed the consolations of religion on the people, preaching in German mingled with Latin. He wrote in German a treatise on "Following the Lowly Life of Christ" (Frankfort, 1621), addressed a remonstrance to the clergy against leaving the dying unattended and unabsolved, and denounced ecclesiastical abuses. Having been summoned by the emperor Charles IV., when at Strasburg in 1348, to render an account of his faith, he disappeared from the city, but returned there shortly before his death. The best of the early editions of his sermons are those of Leipsic (1498), Basel (1521–'2), Halberstadt (1523), and Cologne (1543). There is a modern German translation by Schlosser of his sermons (3 vols., Frankfort, 1826; 2d ed., 1864), and of his *Nachfolgung des armen Lebens Christi* (1833). The hymns attributed to him are of doubtful authenticity.—See Schmidt, *Johannes Tauler von Strasburg* (Hamburg, 1841), and Miss Winkworth, "Life and Times of Tauler," with 25 of his sermons translated from the German (1857).

**TAUNTON**, a city and one of the shire towns of Bristol co., Massachusetts, at the head of navigation on Taunton river, 24 m. from Narragansett bay, 17 m. E. of Providence, R. I., and 32 m. S. of Boston; pop. in 1850, 10,441; in 1860, 15,376; in 1870, 18,629, of whom 4,605 were foreigners; in 1875, 20,429. In shape it is an irregular polygon, having an extreme length N. W. and S. E. of 11 m. and an average width of 6 m. The surface is generally level; half of the land is wooded with forests of pine, oak, beech, and cedar, and there are five ponds of considerable size. It is traversed by the Taunton river and two principal branches, the Canoe and Rumford, which furnish power for many mills and factories. Navigation is impeded by ice but a small part of the winter. The city communicates by rail with Boston, Providence, Fall River, Newport, New Bedford, Cape Cod, and various other points, and has a line of street cars. There are several villages within the city limits. The streets of the central village are well laid out, lighted by gas, and adorned by shade trees of various kinds. The "green" is a well shaded public ground. There are many elegant residences, some of great cost, to which are attached gardens and conservatories. The principal public buildings are the court house, city hall, hotels, school houses, and churches. The

state hospital for the insane occupies a conspicuous site, with grounds of more than 140 acres, and accommodates over 400 patients. Taunton has from the beginning been noted for its manufacture of brick and iron, the latter being at present the leading business, and employing a capital of about $2,000,000. There are two locomotive works, two tack and nail factories, several founderies and machine shops, &c. In copper manufacture a capital of about $900,000 is invested. The Taunton copper company, the oldest and largest in the United States, has been incorporated nearly 50 years. Its products are copper, sheet zinc, and yellow metal sheathing. Among other establishments are two manufactories of silver-plated and britannia ware, four of stove linings and fire brick, two of crucibles, five cotton factories, a flannel factory, a carriage factory, &c. There are three national banks, with an aggregate capital of $1,300,000, and two savings banks, with deposits to the amount of $4,500,000. The coasting trade is important. Taunton and Taunton river are also proverbial for their herring fisheries, the privileges of which are still annually sold, though few of the inhabitants now pursue this branch of industry. Large quantities of shad and alewives are taken from the river in April and May.—The city is governed by a mayor, eight aldermen (one from each ward), and 24 common councilmen. The taxable value of property in 1874 was $18,326,-228; city debt, $275,600. The public schools comprise the following grades: high, 1; grammar, 12; intermediate and primary, 31; ungraded schools, 15. The number of pupils enrolled in 1874 was 3,654; average attendance, 2,522; total expenditure for support of schools, $42,759 58. There are two private schools, an incorporated academy, a public library of 13,000 volumes, and a daily and two weekly newspapers. The principal charitable institutions are the insane asylum, the city almshouse, and a home for aged and infirm women. There are 19 churches, viz.: 2 Baptist, 3 Congregational, 2 Episcopal, 1 Free-Will Baptist, 4 Methodist, 2 Roman Catholic, 3 Unitarian, 1 Universalist, and 1 Union.—Taunton, of which the Indian name was Cohannet, was settled in 1638 by a company from Taunton in England, from whom a large proportion of the present natives of the town are descended. It became a city in 1864. One of the chief promoters of its settlement was Miss Elizabeth Pool, to whom a monument has been erected in the cemetery. In King Philip's war the town was protected from harm by the king's friendship for Thomas Leonard. Here was Philip's favorite hunting ground.

**TAUNTON**, a town of Somersetshire, England, on the Tone, 133 m. W. S. W. of London; pop. in 1871, 15,466. It has an old castle, several places of worship, including the church of St. Mary Magdalen with a fine renovated tower, and various charitable and educational institutions. Among the latter is a college established in 1868 by the Congregationalists at Fairwater, outside of the town. The wool manufactories established in the 14th century have long since declined, and gloves are now the staple industry. In 1645 it was held by Blake for the parliament, and sustained a protracted siege by 10,000 royalists.

**TAURIDA**, a S. government of European Russia, bordering on the governments of Kherson and Yekaterinoslav, the sea of Azov, and the Black sea; area, 24,537 sq. m.; pop. in 1870, 704,997, a large part Tartars. The government includes the Crimea (the Tauris of the ancients, whence the name Taurida), which comprises nearly one third of the area and population, and contains the capital Simferopol, and the principal port and naval station Sebastopol. (See Crimea.) The N. part is a dry elevated country, with a sandy soil impregnated with salt, and without trees, but with some rich valleys that produce luxuriant herbage. Agriculture is little attended to, and the country is chiefly devoted to rearing cattle. A few small streams flow into the sea of Azov, but the only river of importance is the Dnieper on the N. W. frontier. Numerous tongues of land formed by alluvial deposits project from the S. coast, the most extensive of which lies S. of the estuary of the Dnieper, and was anciently called Achilleos Dromos, or Race Course of Achilles. Salt, saltpetre, and naphtha are abundant, and marble is quarried.

**TAUROMENIUM**, an ancient Greek city on the E. coast of Sicily, about half way between Messana and Catana, founded on the hill of Taurus, overlooking the sea, after the destruction of Naxos, 3 m. to the south, by Dionysius the Elder of Syracuse, in 403 B. C. In 394 Dionysius besieged it unsuccessfully for a long time, but it fell into his hands in 392. In 358 Andromachus, the father of the historian Timæus, is said to have collected all the exiled Naxians, and established them at Tauromenium. In 344 Timoleon landed here, but left Andromachus in possession. Subsequently it fell into the hands of Hiero, king of Syracuse. During the servile war in Sicily (134–132) it was desperately defended by the insurgent slaves. It was one of the last places taken from the Greek emperors by the Saracens (906), who destroyed it. The modern village of Taormina occupies its site.

**TAURUS**, a range of mountains in Asia Minor, forming in the main the watershed between the waters flowing into the Mediterranean and those flowing into the Black sea. It consists of two principal chains, the Taurus proper, in the south of the peninsula, and its northeasterly continuation, the Anti-Taurus. With its ramifications in the north, which by former geographers were generally designated as the Anti-Taurus, the range forms three sides of the broad plateau of central and eastern Asia Minor. The commencement of the Taurus proper on the west is a disputed point. Its principal divisions are the Lycian and the Ci-

lician Taurus. It follows closely the sinuosities of the coast, leaving but a narrow margin between; the northern slopes are less abrupt than the southern. Snow-capped peaks are numerous, and fine forests cover the sides of the chain. In the ancient province of Lycia the summits Takhtali Dagh and Ak Dagh are respectively 7,800 and 9,800 ft. high. Gok Dagh, on the confines of ancient Pisidia, Isauria, and Cilicia, is of about equal height with Ak Dagh, while the highest summit of Bulghar Dagh, further east, reaches an elevation of about 11,400 ft. The Ala Dagh connects Bulghar Dagh with the Anti-Taurus, which extends from the W. branch of the Sihun (anc. *Sarus*), through Cappadocia, to the vicinity of the upper Euphrates and the Armenian mountains. The Arjish Dagh (anc. *Argæus*, in Cappadocia), the highest peak of Asia Minor (13,100 ft.), though isolated, is generally reckoned as belonging to the Anti-Taurus. On the whole, however, this chain is less high than the Taurus proper. The Amanus range, E. of the river Sihun (anc. *Pyramus*), connects the Anti-Taurus with the mountain system of Syria. The main pass between the latter country and Asia Minor, called by the ancients the Cilician Gates, is formed by the valley of the upper Cydnus (now Tersus), in the Cilician Taurus, N. W. of Adana.

**TAUSIG, Karl**, a German pianist, born near Warsaw, Nov. 4, 1841, died in Leipsic, July 17, 1871. He studied under his father and Liszt, after whom he ranked as the first pianist in Europe. In 1861–'2 he brought out at Vienna works of Liszt, Wagner, and Berlioz in such a manner as to gain for himself a great reputation as an orchestral director. In 1865 he went to Berlin and was made court pianist, and became the head of the institution for piano virtuosos. He played without notes nearly every great composition from the time of Bach to Liszt.

**TAUTOG.** See BLACKFISH.

**TAVASTEHUUS. I.** A S. W. län or government of Finland, Russia; area, 8,324 sq. m.; pop. in 1872, 193,477, all Lutherans. It is mountainous, and has many lakes. Corn, hemp, flax, and cattle are produced. **II.** A town, capital of the län, 85 m. N. E. of Abo; pop. in 1867, 3,150. The first Finnish railway was opened in 1862 hence to Helsingfors.

**TAVERNIER, Jean Baptiste**, a French traveller, born in Paris in 1605, died in Copenhagen in 1689. He early explored many countries, served occasionally as a soldier, and made six journeys to western Asia and to India, mostly on foot. His father-in-law, a jeweller, having taught him the art of valuing precious stones, he acquired a fortune, was ennobled by Louis XIV. for promoting French trade in India, and bought the barony of Aubonne near the lake of Geneva; but he was ruined by his nephew, and in 1687 fled to Berlin to escape persecutions as a Protestant. There he became director of an East Indian company, and soon undertook a seventh journey, which was interrupted by his fatal illness in Denmark. Louis XIV. bought of him millions of francs worth of diamonds. Under his direction Chappuzeau edited *Les six voyages de J. B. Tavernier* (2 vols., 1676–'7), and La Chapelle a 3d volume in 1679. The latter also reëdited in 1675 *Nouvelle relation de l'intérieur du sérail du grand seigneur*, *Une histoire du Japon*, and *Mémoire sur la conduite des Hollandais*. The first named work has been frequently reprinted and translated (English, 2 vols. folio, 1678–'84).

**TAXES**, the contributions levied by a government upon persons and property, for the use of the government. As a revenue for the use of the state is absolutely essential to the existence of any orderly government, it is reasonable to infer that taxes were levied preceding the earliest of which historical records remain. But in the early ages rulers had other means of supplying their wants without resort to regular levies. One of these might be property of which the state or its ruler had the ownership, the rents or other returns from which rendered taxes unnecessary. In early periods, also, fines and confiscations or compensations for crime constituted an important source of revenue. The early taxes were most severe where the religious worship was supported by this means. Among the Hebrews, in the time of the theocracy, there was a capitation tax of a half shekel (about 30 cts.) payable by every male in the nation (according to some the regular payment of this was of later origin); a tribute of the first fruits, and of the first born of their domestic animals, which might be commuted for money at a fixed rate; a redemption tax for the first born male of the family; and a first and second tithe for the support of the Levites and of the service of the tabernacle, and every third year a third tithe (according to some an application of the second tithe) for the benefit of the poor, and so in some sense a poor rate. After they adopted the regal form of government, the taxes were greatly increased. Solomon collected a large revenue; and the stoning to death of Adoram, "who was over the tribute," and the secession of the ten tribes at the commencement of the reign of his son and successor, indicate how oppressive had been the taxation.—In the Athenian republic there were no direct taxes, either on personal or real estate; the sources of revenue were the lands of the republic, fines and confiscations, the royalty of $\frac{1}{24}$ of the products of the mines, a capitation tax on freedmen and foreigners resident in the republic, customs duties on foreign commodities and merchandise, on which a tariff of 2 per cent. was levied, some excise duties, licenses of markets and houses of prostitution, and tribute paid by other cities and islands. The imposts, licenses, &c., were generally farmed to companies, which gave security for their prompt payment. In times of war, extraordinary contributions were levied

on wealthy citizens, or an appeal was made to their patriotism. The common people, so far from paying any tax except the duty on the goods they purchased, received from the state large appropriations for public games and spectacles. In Rome, under the republic, the spoils of conquered nations and the annual tribute exacted from them defrayed the greater part of the expenses of the state; but under the empire it was found necessary to resort to numerous devices of taxation, portions of the territorial revenues were sequestrated, capitation taxes levied, tolls, taxes on corn, and legacy and hereditary duties collected, heavy sums exacted for the privilege of Roman citizenship, &c. During a large part of the middle ages, under the feudal institutions, there was no system of taxation. The kings were maintained by the products of their land, and in case of war their vassals, the barons and knights, were under obligation to furnish their quota of men-at-arms equipped and provisioned without expense to the monarch; and this military service was performed by their tenants by way of rental for the lands they cultivated. The first approach to modern systems was made during the middle ages by the republic of Venice, which levied taxes on the lands of the republic, and also in the form of duties on manufactures and imports; these duties, which brought in a large revenue, were imposed on the necessaries as well as the luxuries of life. In France, prior to the revolution, there was a serious obstacle to any equitable system of taxation in the fact that the nobility and clergy, the privileged classes as they were termed, were exempted from its burdens. In England the finances for centuries were badly managed; there was little encouragement to industry, and the taxes, whether direct or indirect, were insufficient for the expenses of the government. The privileged classes were exempted as in France. Resort was often had to the sale of monopolies, and to forced loans, contributions, and confiscations. In most of the other countries of Europe no taxes were levied on the clergy or the nobles. In the countries of western Asia, the government of provinces with the right of taxation was bestowed on favorites, or sold to the man who would pay highest for it; and as the duration of the government of these rulers was short, they practised the most cruel extortion, completely annihilating industry, and often transforming countries once prosperous and populous into desert wastes.—Taxes are either direct or indirect. The former are those which are levied upon the persons, property, business, income, &c., of those who are to pay them; the latter are levied on commodities in the hands of manufacturers and dealers, and will be paid ultimately by consumers as a part of the price of the commodity. Presumptively the former are paid by the persons taxed, while as to the latter the persons who make payment to the government only advance to it the taxes, expecting to reimburse the amount in their sales and thus transfer the tax to the purchasers. They constitute therefore as to these taxes the collectors for the government, collecting with ease and convenience from the whole body of consumers a tax which it would be difficult and expensive, perhaps impossible, for the government to collect from the several consumers after the articles taxed have passed into their hands. But though direct taxes presumptively fall upon the persons taxed, a portion of the burden is usually transferred to others, and is diffused through the community in a manner that renders it impossible to indicate the precise extent. A direct tax on lands is paid by the land owner; but if the revenues of the state were principally collected from this source, the necessary result would be such an increase in the price of everything which the land produces as would transfer to consumers a large proportion of the tax, and thus have the effect of an indirect tax upon them. A like result must follow the taxation of professional incomes, unless the incomes of other callings are taxed proportionably, so as to equalize the burden by the tax law itself, instead of leaving it to be equalized by the increase in price of whatever those who pay the tax have to sell, as compared with the price of what is sold by those who are not taxed. A process of equalization of this nature must always be going on when one class of property or occupation is taxed and another exempted. —The true principles of taxation were little understood until the time of Adam Smith, and even now are in many particulars the subject of earnest controversy. That writer laid down maxims of taxation as follows: "1. The subjects of every state ought to contribute toward the support of the government, as nearly as possible, in proportion to their respective abilities; that is, in proportion to the revenue which they respectively enjoy under the protection of the state. 2. The tax which each individual is bound to pay ought to be certain, and not arbitrary; the time of payment, the manner of payment, and the quantity to be paid, ought all to be clear and plain to the contributor and to every other person. 3. Every tax ought to be levied at the time and in the manner in which it is most likely to be convenient for the contributor to pay it. 4. Every tax ought to be so contrived as both to take out and keep out of the pockets of the people as little as possible over and above what it brings into the public treasury of the state." Prof. Amasa Walker, in his "Science of Wealth," adds to these the following, which he justly says has been adopted in every country having any considerable taxation: "5. The heaviest taxes should be imposed on those commodities the consumption of which is especially prejudicial to the interests of the people." The first of these maxims has met with little or no recognition except in recent times. It has already been said that until recently,

even in the most civilized countries, precisely those classes who enjoyed the largest revenue, and presumptively were most able to contribute to the support of government, were exempted altogether. The modern idea not only accepts this first maxim, but it goes somewhat further in a direction opposite to the practice of former times, and holds that revenue which is only sufficient for the support of the person and his family should be regarded as not subject to taxation at all, but the whole burden should be levied upon the large revenues. Full effect is seldom given to this idea, but its recognition is seen in the exemption of small incomes when an income tax is laid, and in the exemption of household furniture, tools of trade, &c., when property is taxed by value. While this first maxim is true in a general sense, there are many exceptions to be made to it, and no tax system ever professes to be framed in strict accordance with it. The land owner who voluntarily allows his lands to lie idle and produce no returns, and thus avoids contributing to the common benefit of society, has no claim to exemption; and as his property is meanwhile protected by the government, it is only reasonable that he should make due return for this protection. A man possessed of large means may have them invested in a large establishment, fine grounds, elegant collections of art, &c., which a moderate income enables him to support; while another whose whole capital is kept in productive employment may realize no greater income from his comparatively small means, supplemented by his own labor. Obviously in such cases income could not be a proper standard of taxation as between the two. To render the maxim just in all cases, other than pecuniary returns must be had in view, and the standard of taxation must embrace something besides income. In modern times complicated systems have generally been established in which taxes have been laid on expenditure as well as on income, and to these have been added taxes on the value of property, the purpose being to levy a diversity of taxes which, as they work together, will be likely to result in distributing the burdens of government more equally and justly than any single tax could possibly do. The second maxim is one that should admit of no exception when direct taxes are laid; but when taxes are indirect, one of their chief advantages is supposed to be that they are paid by the people without their being aware at the time that they are paying taxes at all, or at least without reflection on their part that what they pay as price includes a tax. The third maxim is sometimes had in view in the imposition of taxes in kind, but it must be very rare indeed that this method of obtaining a revenue can be either convenient to the people or economical to the government. Only when extraordinary circumstances preclude a ready exchange of the products of the country for money, such as for a time existed while the southern states of the Union were in insurrection against the government, could taxes in kind be preferable either to the tax payers or to the government. The exchange of property for money is always better done by individuals than by the government, and the government consults the interests of the people by making taxes payable at the season of the year when the harvests have generally been gathered, and when it is presumed the tax payers can most conveniently meet the demand. The fourth maxim is often violated by large and needless accumulations in the public treasury, which are impolitic for the further reason that they tend to extravagance and corruption and invite peculation. One important measure which governments adopt has express reference to this maxim, viz., the warehousing system, under which the importer, instead of being compelled to pay the customs duties on the arrival of the goods, and to charge his customers with the consequent loss of interest until sales are made, is permitted to leave them in store, and to pay the duties when the goods are withdrawn for sale. Mr. Walker's supplementary maxim is had in view in all well regulated governments. Spirituous and fermented liquors and tobacco are usually made to pay heavy taxes, while breadstuffs are exempt, or only taxed as a part of the general property of the country by value; and at the same time perhaps license taxes will be imposed upon dealers in spirits and tobacco, and also upon the keepers of billiard tables and places of amusement.—The taxes which have been laid at different times have been almost infinite in variety, depending sometimes mainly on considerations of policy, while at others the necessities of government have compelled it to make use of every available means of extracting money from the people. One of the earliest taxes was perhaps a capitation tax, but this can seldom be reasonably fair or equal, because it can take no account of the differences in condition, resources, or income of the persons taxed. The land tax was also an early device, and the feudal services easily slid into a burden of this character. A land tax as a part of a system of taxes may be a just tax, and by itself may not be so unequal or unjust as would at first be supposed. Land is the most available resource for direct taxation, and in this country land is found in the hands of so large a portion of the people that the states are enabled to raise the greater part of their revenues from this source without exciting any general feeling of discontent. Land taxes may be measured by area, which, except in the case of assessments for some local purposes, must always be unequal, or they may be measured by rents or by value. A house tax is common in other countries, and was formerly measured by windows or hearths; but as the adoption of either standard tended to diminish the number of the convenience which was the measure of the tax, the rent or rental value is generally

substituted. The income tax, however just in theory, has always proved unequal from the impossibility of obtaining accurate returns, and unpopular from the necessity it involved of prying into the business and private concerns of the people. Great use has however been made of it in England, where one has been imposed ever since 1842, undergoing in the mean time 18 alterations, the rate ranging from 16*d.* in the pound to 2*d.* In some tax laws incomes are graded, and those are taxed least which are derived from property otherwise taxed, or which for any reason it is thought should not be taxed as high as others. In America an income tax has always been exceptional. Excise taxes are laid in great variety, and in some countries produce the larger portion of the revenue. The heaviest are usually those on the manufacture of liquors; these have sometimes been made so heavy as to furnish strong inducements to evasion, and by various ingenious contrivances, combined usually with corruption of the revenue officers, the heavy tax is made less productive than a light one. Excise taxes are also laid on employments in various forms, on the profits of business and of corporations, &c. A succession tax, or a tax on the privilege of succeeding to an inheritance or to a testamentary gift, has been customary. When the succession is collateral, or out of the immediate family of the deceased, it comes in diminution of a new capital and will not be burdensome; but when paid by the immediate family of the deceased, the burden is more felt, because that from which the tax is taken was, for all purposes of comfort and enjoyment, the property of the family before. Customs taxes are in some countries next in productiveness to excise taxes, while in others they are much more productive. They are favorite taxes with governments because they are easy of collection, and because the people submit to them more willingly than to either the direct or the indirect internal taxes. They are objectionable because of the strong invitation they hold out to smuggling, which is greater in proportion as the tax is heavy, and also because of the temptation they offer for discriminating legislation for the benefit of particular occupations or to build up monopolies. Protective taxation is usually laid in this form. Either an excise or a customs tax will be productive in proportion as the article taxed is one in general use, and as the government succeeds in collecting the tax and preventing evasions. An export tax is not often laid, it being thought impolitic as tending to diminish exportation and production, and also because, to the extent that it seems to transfer to purchasers in other countries the burdens of the government imposing it, the tendency is to invite retaliatory legislation. A property tax by value has very generally been regarded in America as the most equal and just of all taxes. Practically it falls mainly on real property, from the difficulty of discovering and listing personalty except in its most tangible forms. Stamp taxes are laid in various forms: on manufactured articles, bills of exchange, checks, deeds, contracts, and other instruments of business or traffic, on the process of courts, letters of administration, &c., and sometimes on newspapers. No taxes are so easily, cheaply, or conveniently collected as these, and when levied on articles selected with a view to a fair distribution of the burden, none could be more just. In the United States they are generally abandoned except for the purposes of the excise on manufactures. The enjoyments and amusements of the wealthier classes are sometimes taxed specially, the taxes being imposed in respect to their servants, horses, carriages, dogs, plate, &c. The interest of money is sometimes taxed specially; so are dividends of corporations and joint stock companies; so sometimes are indentures of apprenticeship, and even marriages. Many light taxes are laid for regulation merely, usually in the form of license fees. A principle generally accepted is, that articles of luxury should be selected for taxation to the relief of articles of prime necessity. This tends to cast the burden upon those best able to bear it, and at the same time leaves every man to tax himself, since his purchases are made of choice and not from necessity. But this by no means has the effect at all times to make the weight of taxes fall upon the wealthier classes. Mr. R. D. Baxter estimates the taxes paid by the manual labor classes of Great Britain on alcoholic drinks and tobacco at $6\frac{1}{10}$ per cent. of their income, and those paid by the upper and middle classes on the same articles at $2\frac{3}{10}$ per cent.—The official figures of European budgets convey no adequate idea of the relative taxation in the respective countries, because in one country they may embrace the taxes levied for many purposes which in another will be provided for by taxes not brought into the corresponding budget. Furthermore, no adequate returns are anywhere made of the items of local taxation, which constitute a large proportion of the aggregate taxes. These local taxes in Great Britain are estimated to exceed £30,000,000. Any comparison between the taxation of the United States and that of the European countries would also be likely to mislead, unless it brought into view the taxation of the several states as well as that of the nation. Taxation in the United States ranges itself under the three heads of federal, state, and municipal. The first is laid almost wholly in the form of customs and excise duties. The figures for the fiscal year 1875 were:

| | | |
|---|---|---|
| Customs duties | | $157,167,722 00 |
| Taxes on distilled liquors | $52,081,991 12 | |
| " on fermented liquors | 9,144,391 66 | |
| " on tobacco | 37,303,670 06 | |
| Stamp taxes | 6,088,590 42 | |
| Taxes on banks | 4,096,860 87 | |
| Penalties and other items | 1,138,700 98 | |
| Total internal taxes | | 109,849,205 11 |
| Total of taxes | | $267,016,927 11 |

State taxation is usually laid for general state purposes only. The bulk of all state taxation is laid upon property by a periodical valuation. In some states these are supplemented by taxes on occupations or "privileges," on the franchises of corporations, &c. Taxes on those occupations which are transient and those which are thought to require peculiar supervision and regulation are usual in all the states. Municipal or local taxation is commonly very much heavier than state taxation. It embraces: 1, all taxes laid for the general purposes of counties, cities, boroughs, towns, and villages; and 2, those local taxes which are usually called assessments, and which are laid in special districts supposed to be peculiarly benefited by the construction of some public work, and by some rule of apportionment which proposes to charge each item of property within the district in proportion to the benefit it will receive. Taxes on this principle are often, though not always, laid for the opening and improvement of streets, for sewerage and lighting in cities, for country drains, for levees and embankments, &c. The legislature directs these to be provided for by general taxation of the municipality, or by local assessments, as it deems most just, or it confers upon the municipality within which the work is to be done a discretion in the premises.—The methods of collecting taxes are various. Formerly in some countries the collection of the revenue was farmed out to contractors, but this led to enormous abuses and oppressions, and is no longer thought of. Customs duties are usually collected by requiring everything imported to pass through the hands of government officers, and the tax to be paid before the goods pass beyond their control. Excise taxes may be imposed in the form of stamps, and collected in a sale of the stamps, to be affixed either by the person taxed or by some official. Assessed taxes are mainly collected by a collector to whom a tax list and warrant is issued, and who is authorized to distrain goods, and perhaps to take the body of the person taxed. In the United States taxes on lands are generally permitted to be enforced by a sale of the lands after other means of collection are exhausted. Much use is made of penalties under revenue laws, not only for the punishment of frauds and evasions, but also to compel the furnishing of lists, returns, &c.—Many things are usually exempt from taxation. Indeed, any taxation is only a selection of subjects to be taxed, leaving everything else exempt; but where special classes of persons, occupations, property, &c., are taxed, many exemptions are made. Public property is usually exempt, and this includes court houses, public school buildings, asylums, &c. Houses of worship are also generally exempted, and sometimes the property of clergymen; the idea being that this indirect encouragement to religious worship is for the good of the state, and also, perhaps, that as the community in general contribute in some form to the maintenance of churches, this exemption produces no considerable inequality. Special exemptions of individuals in any class taxed are usually unjust, and in the United States, except when made for a consideration, must be regarded as forbidden by constitutional principles.—Taxation and protection are regarded as reciprocal rights and duties. But protection is the consideration rather for the liability to taxation than for actual taxation; as, if the government should see fit to collect all its taxes from lands, persons owning no lands and therefore not taxed, but liable to be taxed, would be equally entitled to protection with the land owner himself. In Great Britain and the United States it is a constitutional maxim that taxation and representation go together, and the people's representatives vote the taxes which the people are to pay. A violation of this maxim led to the American revolution. The exact force of the maxim is not well determined. It is not usually in doubt so far as the general taxes for the use of the state are concerned: these must be granted by the legislature; but in the case of local taxes some questions remain to be determined. There can be no doubt that local powers to tax are not inherent in the municipalities, but must be conferred by the state. Usually they are conferred with proper restrictions, and the municipalities are then left to exercise them at discretion. And it must be conceded that when the powers are to be employed for purely local purposes in which the commonwealth at large has no concern, this maxim would be disregarded if liberty in the premises were not left to the people directly interested; and this in the United States is customary.—See Leone Levi, "On Taxation, how it is Raised and how Expended" (London, 1860); Parieu, *Traité des impôts considérés sous le rapport historique, économique et politique en France et à l'étranger* (5 vols., Paris, 1862-'4); Sir Morton Peto, "Taxation, its Levy and Expenditure, past and future" (New York, 1866); R. Dudley Baxter, "The Taxation of the United Kingdom" (London, 1869), and "Taxation and Local Government" (1874); George J. Goschen, M. P., "Local Taxation" (London, 1872); Sargeant, "Taxation, Past, Present, and Future" (London, 1874); R. S. Blackwell, "Tax Titles" (3d ed., Boston, 1874); "Local Government and Taxation," edited by J. W. Probyn ("Cobden Club Essays," 1875); Francis Hilliard, "The Law of Taxation" (Boston, 1875); and Thomas M. Cooley, "The Law of Taxation" (Chicago, 1876).

**TAXIDERMY** (Gr. τάξις, arrangement, and δέρμα, a skin), the art of preparing the skins of animals so that they retain their natural appearances, and also of arranging them in the forms and natural positions of the animals from which they are taken. This often includes the preservation of the skeleton or parts of the skeleton, which is replaced as being the

most convenient model or frame on which the skin can be placed. The art also includes the preservation of the whole of the bodies of small animals, which in such cases is synonymous with embalming. The principal operations in taxidermy are the removal of the skin, which requires much care and dexterity, and its treatment with some preserving preparation, as arsenical soap, composed of arsenic 1 oz., white soap 1 oz., carbonate of potash 1 dr., distilled water 6 drs., camphor 2 drs. This soap prevents the attacks of insects and keeps the skin soft. The larger skins are often treated with the following preparation, called "preservation powder:" arsenic and burnt alum each 1 lb., ground oak bark 2 lbs., camphor ½ lb. Gloves should be used in applying the preparation. Corrosive sublimate, carbolic acid, and more recently salicylic acid, have been used in different ways with success. There are so many details that directions cannot be given in this place.—See directions by Prof. S. F. Baird in the "Report of the Smithsonian Institution" for 1856; Swainson's "Taxidermy," forming a volume of Lardner's "Cabinet Cyclopædia;" and the "Taxidermist's Manual," by Capt. Thomas Brown, F. Z. S. (New York, 1875).

**TAY,** a river and loch of Perthshire, Scotland. The river rises in a small loch on the border of Argyleshire, and is called the Fillan until it passes through Loch Dochart, 8 or 9 m., and thence to Loch Tay, 10 m. further, it is generally known as the Dochart. Near Loch Tay it receives the Lochie, and below that loch the river Lyon and numerous other tributaries. It is nearly 120 m. long, and describes almost a semicircle, flowing mainly N. E. and S. E., until it reaches Perth, whence it flows nearly E. through the frith of Tay into the North sea. It has tide water and is navigable for vessels of 9 ft. draught to Perth. Above this point it flows through the finest valley of Scotland, and it discharges a larger volume of water than any other river of the British islands. Its salmon fisheries are celebrated. Loch Tay is about 16 m. long and 1 m. wide, with steep, precipitous banks, and is said to have been sounded to a depth of 600 ft. Ben Lawers, on its N. W. shore, rises to a height of 3,984 ft.

**TAYGETUS.** See LACONIA.

**TAYLOR,** the name of six counties in the United States. **I.** A N. county of West Virginia, intersected by the Tygart's Valley river; area, 130 sq. m.; pop. in 1870, 9,367, of whom 343 were colored. The surface is very hilly, and the soil in some parts fertile. Iron ore and bituminous coal are abundant. The chief productions in 1870 were 28,684 bushels of wheat, 95,439 of Indian corn, 45,166 of oats, 10,305 of potatoes, 97,233 lbs. of butter, 17,233 of wool, and 6,710 tons of hay. There were 1,685 horses, 1,791 milch cows, 4,638 other cattle, 6,000 sheep, and 2,651 swine; 4 tanneries, 2 iron founderies, 5 flour mills, 7 saw mills, and 2 machine shops. Capital, Pruntytown. **II.** A W. county of Georgia, bounded N. and E. by Flint river and drained by Whitewater and other creeks; area, about 400 sq. m.; pop. in 1870, 7,143, of whom 2,962 were colored. The surface is undulating and the soil generally fertile. It is intersected by the Southwestern railroad. The chief productions in 1870 were 5,962 bushels of wheat, 119,269 of Indian corn, 6,491 of oats, 16,344 of sweet potatoes, and 3,559 bales of cotton. There were 348 horses, 654 mules and asses, 1,320 milch cows, 3,463 other cattle, 1,159 sheep, and 6,339 swine; 1 cotton factory, 2 flour mills, and 9 saw mills. Capital, Butler. **III.** A N. county of Florida, bounded S. W. by the gulf of Mexico and W. by the Ocilla river, and drained by several streams; area, 1,100 sq. m.; pop. in 1870, 1,453, of whom 79 were colored. The surface is level and the soil sandy. The chief productions in 1870 were 20,625 bushels of wheat, 9,535 of sweet potatoes, 244 bales of cotton, 6 hogsheads of sugar, and 4,369 gallons of molasses. There were 117 horses, 1,040 milch cows, 4,340 other cattle, and 4,650 swine. Capital, Perry. **IV.** A N. W. county of Texas, drained by Clear fork of Brazos river; area, 900 sq. m.; returned in 1870 as having no population. The surface is mostly table land, with little timber or water. **V.** A central county of Kentucky, drained by affluents of Green river; area, about 275 sq. m.; pop. in 1870, 8,226, of whom 1,850 were colored. The surface is hilly and the soil fertile. The chief productions in 1870 were 27,744 bushels of wheat, 239,581 of Indian corn, 55,867 of oats, 11,959 of potatoes, 1,209,830 lbs. of tobacco, 17,040 of wool, 95,869 of butter, and 1,219 tons of hay. There were 2,414 horses, 1,689 milch cows, 2,306 other cattle, 8,046 sheep, and 13,508 swine. Capital, Campbellsville. **VI.** A S. W. county of Iowa, bordering on Missouri and drained by East Nodaway, One Hundred and Two, and Platte rivers; area, 560 sq. m.; pop. in 1870, 6,989. The surface is generally level and the soil fertile. The chief productions in 1870 were 56,852 bushels of wheat, 438,089 of Indian corn, 85,886 of oats, 38,507 of potatoes, 33,868 lbs. of wool, 120,167 of butter, and 14,174 tons of hay. There were 2,744 horses, 2,559 milch cows, 6,898 cattle, 9,953 sheep, and 10,568 swine; 2 flour mills, 3 saw mills, and 1 woollen factory. Capital, Bedford.

**TAYLOR, Bayard,** an American author, born in Kennett Square, Chester co., Pa., Jan. 11, 1825, died in Berlin, Prussia, Dec. 19, 1878. In 1842 he became an apprentice in a printing office. In 1844–'5 he made a pedestrian tour in Europe, and in 1846 published "Views Afoot, or Europe seen with Knapsack and Staff." For a year he edited a newspaper in Phœnixville, Pa., then went to New York, wrote for the "Literary World," and soon after joined the editorial staff of the "Tribune," in which journal many of his subsequent works of travel first appeared. In 1849 he visited

California, and returned home by the way of Mexico. In 1851 he set out on a protracted tour in the East, in the course of which he ascended the Nile to lat. 12° 30′ N., and afterward traversed large portions of Asia Minor, Syria, and Europe; and in the latter part of 1852 he made a new departure from England, crossing Asia to Calcutta, and thence proceeding to China, where he joined the expedition of Commodore Perry to Japan; and he afterward made several other journeys. In 1862–'3 he was secretary of legation at St. Petersburg, and part of the time chargé d'affaires. In 1874 he revisited Egypt, and attended the millennial celebration in Iceland; and in Feb., 1878, he was appointed minister to Germany, where he had previously resided several years at intervals. He was also well known as a lecturer. Besides his "Views Afoot," he published "El Dorado, or Adventures in the Path of Empire" (2 vols. 12mo, 1850); "A Journey to Central Africa" (1854); "The Lands of the Saracen" (1854); "A Visit to India, China, and Japan" (1855); "Northern Travel: Summer and Winter Pictures of Sweden, Denmark, and Lapland" (London, 1857; New York, 1858); "Travels in Greece and Russia" (1859); "At Home and Abroad, a Sketch Book of Life, Scenery, and Men" (1859; 2d series, 1862); "Colorado, a Summer Trip" (1867); "By-Ways of Europe" (1869); and "Egypt and Iceland" (1874). His volumes of poems are: "Ximena, or the Battle of the Sierra Morena, and other Poems" (Philadelphia, 1844); "Rhymes of Travel, Ballads, and other Poems" (1848); "The American Legend," a poem delivered before the Phi Beta Kappa society of Harvard university (1850); "Book of Romances, Lyrics, and Songs" (1851); "Poems and Ballads" (1854); "Poems of the Orient" (1855); "Poems of Home and Travel," a selection from his early lyrics (Boston, 1855); "The Poet's Journal" (1862); "The Picture of St. John" (1866); "The Ballad of Abraham Lincoln" (1869); "The Masque of the Gods" (1872); "Lars, a Pastoral of Norway" (1873); "The Prophet, a Tragedy" (1874); and "Home Pastorals, Ballads, and Lyrics" (1875). He also published the novels "Hannah Thurston, a Story of American Life" (1863), "John Godfrey's Fortunes" (1864), "The Story of Kennett" (1866), and "Joseph and his Friend" (1870). He translated in the original metres both parts of Goethe's "Faust" (1870–'71), and edited a "Cyclopædia of Modern Travel" (Cincinnati, 1856), "Frithiof's Saga," translated by W. L. Blackley from the Swedish of Tegnér (1867), Auerbach's "Villa on the Rhine" (2 vols., 1869), and "Illustrated Library of Travel, Exploration, and Adventure" (vols. i.–iv., 1872–'4). Several of his works have been translated into German, French, and Russian. He had been long engaged upon a biography of Goethe, which he left unfinished.

**TAYLOR, Brook,** an English mathematician, born at Edmonton, Aug. 18, 1685, died in or near London, Dec. 29, 1731. In 1701 he entered St. John's college, Cambridge, and in 1708 wrote his treatise on the "Centre of Oscillation," which was published in 1713 in the "Philosophical Transactions." In 1712 he was chosen a fellow of the royal society, and from 1714 to 1718 was its secretary; and he contributed papers on magnetism and mathematical subjects. His *Methodus Incrementorum* (1715) is the first treatise in which the calculus of finite differences is proposed for consideration, and contains the first enunciation of the celebrated theorem which bears his name. In 1715 he conducted a controversial correspondence with Count Raymond de Montmort on the tenets of Malebranche, and in 1719 he published his "New Principles of Linear Perspective." His *Contemplatio Philosophica* was published posthumously, with a memoir by his grandson, Sir William Young (1793). He left a number of works which are still unpublished.

**TAYLOR, Edward T.,** an American clergyman, born in Richmond, Va., Dec. 25, 1793, died in Boston, April 6, 1871. From 7 to 17 years of age he was a sailor boy. Captured on a privateer in the war of 1812, he was imprisoned at Dartmoor, England, and acted as chaplain to the prisoners. In connection with the New England Methodist conference he began stated labors and continued nine years, till about 1828, when he became chaplain of the Boston seamen's bethel, which post he retained till his death, acquiring a world-wide fame as the eloquent sailors' preacher. For many years he was known as Father Taylor. He visited Europe in 1832, and Palestine in 1842; and he was chaplain of the Macedonian, sent in 1846 to the relief of the starving poor of Ireland.

**TAYLOR, George,** a signer of the Declaration of Independence, born in Ireland in 1716, died in Easton, Pa., Feb. 23, 1781. After receiving a good education, he came to America as a "redemptioner," and bound himself for a term of years to an iron manufacturer at Durham, Pa. His employer subsequently made him his clerk, and after his death Taylor married his widow and became master of the establishment. He was a member of the provincial assembly from 1764 till 1770, when he was made a judge of the county court and colonel of militia. In October, 1775, he was again elected to the provincial assembly. He was elected to the continental congress on July 20, 1776, signed the Declaration on Aug. 2, and in March, 1777, retired from congress.

**TAYLOR, Sir Henry,** an English poet, born in 1800. In 1824 he entered the colonial office, where he has long been one of the five senior clerks. His earliest publication was "Isaac Comnenus, a Play" (1827), and he is best known by two dramas in blank verse, "Philip van Artevelde" (1834) and "Edwin the Fair" (1842). His other works include "The Eve of the Conquest, and other Poems" (1847); "Notes from Life, in Six Essays" (1847); "Notes from Books, in Four Essays" (1849);

"The Virgin Widow, a Play" (1850); and "St. Clement's Eve, a Play" (1862). A collective edition of his plays and poems was published in 1863 (3 vols. 8vo).

**TAYLOR, Isaac,** an English author, born at Lavenham, Suffolk, Aug. 17, 1787, died at Stanford Rivers, Essex, June 28, 1865. His father, Isaac Taylor, originally a line engraver, became a dissenting minister, and wrote several popular books for children. His mother, Ann Taylor, wrote "Maternal Solicitude" and other educational works. The son was trained as an artist, but devoted himself to literature, and also displayed much mechanical ingenuity in his invention of an engraving machine which was employed in producing the plates for Traill's Josephus, and a machine for engraving patterns on rollers for calico printing, now in use in Manchester. Some of the designs from his pencil were engraved for Boydell's Bible. Though brought up as a dissenter, he became a member of the established church. In 1862 he received a civil service pension of £100 for his services to literature in the departments of history and philosophy. He published "Elements of Thought" (1822); "History of the Transmission of Ancient Books to Modern Times" (1827); "The Process of Historical Proof Exemplified and Explained" (1828); "Balance of Criminality, or Mental Error compared with Immoral Conduct" (1828); and a translation of Herodotus with notes (1829). In 1829 appeared anonymously his "Natural History of Enthusiasm," which was received with extraordinary favor, and was followed by "A New Model of Christian Missions" (1829); "Saturday Evening" (1832); "Fanaticism" (1833); "Spiritual Despotism" (1835); and "Physical Theory of Another Life" (1836), the last leading to the surrender of the author's *incognito.* His other works are: "Home Education" (1838); "Ancient Christianity, and the Doctrines of the Oxford Tracts for the Times" (8 parts, 1839–'40; 4th ed., with supplement and indexes, 2 vols. 8vo, 1844); "Man Responsible for his Dispositions, Opinions, and Conduct" (1840); "Lectures on Spiritual Christianity" (1841); "Loyola, and Jesuitism in its Rudiments" (1849); "Wesley and Methodism" (1851); "The Restorations of Belief" (1855); "The World of Mind" (1857); "Logic in Theology, and other Essays" (1859); "The Liturgy and the Dissenters," and "Ultimate Civilization, and other Essays" (1860); "The Spirit of Hebrew Poetry" (1861); and "Considerations on the Pentateuch" (1863).—His brother JEFFREYS published a number of popular books for young people. His sisters ANN (died 1866) and JANE (1783–1824) published "Original Poems" and "Hymns" for children, and "Hymns" for Sunday schools. (See "Autobiography and other Memorials of Mrs. Gilbert, formerly Ann Taylor," edited by Josiah Gilbert, 2 vols., London, 1874.) Jane also published "Display," a tale (1815), and "Contributions of Q. Q." (1824); and her "Memoirs, Correspondence, and Poetical Remains" appeared in 1825 (2 vols.).—His son ISAAC, a clergyman of the established church, has published "Words and Places" (1864; enlarged ed., 1865), which attempts to give a complete explanation of the local names of Great Britain; "The Family Pen: Memorials Biographical and Literary of the Taylor Family of Ongar" (2 vols., 1867); and "Etruscan Researches" (1874).

**TAYLOR, Isidore Séverin Justin,** baron, a French author of English origin, born in Brussels, Aug. 15, 1789. After studying art he served several years in the French army, reaching the rank of major, and afterward travelled in Italy, Greece, and the East, bringing back rich collections, which he placed in the galleries and museums of Versailles and Paris. He exerted himself to procure from the French chambers the restoration of the principal monuments of the middle ages in France; in 1824 was made royal commissary of the Comédie Française; and at the direction of the government twice visited Egypt, and negotiated the transfer to France of the obelisks of Luxor and other Egyptian antiquities. He was made a senator in 1869. In connection with C. Nodier and De Caillieu, he edited the illustrated *Voyages pittoresques et romantiques dans l'ancienne France* (fol., 1820–'54); *Voyage pittoresque en Espagne, en Portugal et sur la côte d'Afrique de Tanger à Tétouan* (4to, 1826 *et seq.*); *La Syrie, l'Égypte, la Palestine et la Judée* (4to, 1837 *et seq.*); *Pèlerinage à Jérusalem* (1841); and *Voyage en Suisse, en Italie, en Sicile, en Angleterre, en Écosse, en Allemagne, en Grèce,* &c. (1843).

**TAYLOR, Jeremy,** an English theologian, born in Cambridge in 1613, died at Lisburn, Ireland, Aug. 13, 1667. His father was a barber and surgeon, and he was educated as a sizar at Cambridge, but obtained a fellowship at Oxford in 1636, and in 1638 the rectory of Uppingham in Rutland. In the civil wars he adhered to Charles I., who made him his chaplain, and for a defence of episcopacy written at the king's request commanded his admission to the degree of D. D. in 1642. The same year his rectory was sequestered by the parliament, but he continued to write for the royal cause till 1645, when he was obliged to retire into Wales, where he maintained himself by teaching school, and wrote some of his most important works. His "Liberty of Prophesying" (1647), in behalf of toleration, was published at the very crisis of the civil struggle. This was followed by his "Holy Living and Dying" (1650–'51), now perhaps the best known of his works, and "The Great Exemplar, or the Life and Death of the Holy Jesus" (1653). He subsequently preached occasionally in London, and suffered several short imprisonments on account of his royalist sympathies. He was also censured by his own party for some expressions thought to indicate Romanist views,

and in 1658 was imprisoned in the tower in consequence of his publisher having prefixed to his collection of offices a print of Christ in the attitude of prayer. He was released through the efforts of Evelyn, and on the invitation of the earl of Conway removed to the north of Ireland. In 1660 he went to London to publish his "Ductor Dubitantium," the most extensive work on casuistry in the English language. While there he signed the royalist declaration of April 24, and Charles II. on his restoration nominated him bishop of Down and Connor, to which the bishopric of Dromore was soon added. He was shortly afterward made a member of the Irish privy council, and elected vice chancellor of the university of Dublin. His second wife was a natural daughter of Charles I. As a writer of sermons Bishop Taylor stands preëminent. His complete works were published by Bishop Heber with a memoir (15 vols., London, 1820–'22), and his life by R. A. Willmott (London, 1847).

**TAYLOR, John**, an English author, called "the water poet," born in Gloucester in 1580, died in London in 1654. He was educated at the free school of Gloucester, and was apprenticed to a London waterman, an occupation which he followed during the greater part of his life. In 1596 he served in the fleet under the earl of Essex, and was present at the attack upon Cadiz. After his return he plied on the Thames, and collected the lieutenant of the tower's demand on imported wines. Subsequently he kept a public house in Phœnix lane, Long Acre. His publications, in prose and in verse, amounting to upward of 80, are of value as illustrations of opinions and manners during the first half of the 17th century. They were published in folio in 1630. Two of the most curious of his prose works are devoted to descriptions of a journey on foot to Scotland in 1618, and of another, made principally in a boat, from London to Hereford in 1641.

**TAYLOR, John**, an English minister, born near Lancaster in 1694, died at Warrington, March 5, 1761. He was educated at Whitehaven, and settled for 18 years as teacher and minister at Kirkstead in Lincolnshire. In 1733 he was chosen pastor of a Presbyterian congregation at Norwich, where he preached for 24 years, and avowed anti-Trinitarian sentiments. In 1757 he became principal of the dissenting academy at Warrington. His principal published works are: "The Scripture Doctrine of Original Sin" (1738); "A Paraphrase on the Epistle to the Romans" (1745); "The Scripture Doctrine of the Atonement" (1750); "An Hebrew English Concordance" (2 vols. fol., 1754–'7); and "A Scheme of Scripture Divinity" (1762), edited by his son.

**TAYLOR, Nathaniel William**, an American clergyman, born in New Milford, Conn., June 23, 1786, died in New Haven, March 10, 1858. He graduated at Yale college in 1807, studied theology, and in 1812 was ordained pastor of the first church (Congregational) in New Haven, and became eminent as a preacher. In 1822 he was called to the Dwight professorship of didactic theology in Yale college, in which office he continued till his death. In 1828 he preached at New Haven the *concio ad clerum*, in which he set forth views upon human depravity and other related doctrines which caused him to be widely denounced for heresy; and for several years he maintained a vigorous discussion of these and similar topics, through the quarterly "Christian Spectator." Since his death four volumes of his works have been published, viz.: "Practical Sermons" (8vo, New York, 1858); "Lectures on the Moral Government of God" (2 vols., 1859); and "Essays, Lectures, &c., upon Select Topics in Revealed Theology" (1859).

**TAYLOR, Richard**, an English printer, born in Norwich, May 18, 1781, died in Richmond, Dec. 1, 1858. He studied the classical and other languages and literature while learning the printer's trade in London, and in 1803 established himself in business with his father; and his press soon became the medium through which nearly all the more important works in scientific natural history were published. In 1807 he became a fellow of the Linnæan society, and in 1810 was elected its under-secretary, an office which he held nearly half a century. He also attached himself from the commencement to the "British Association for the Advancement of Science." In 1822 he became a joint editor of the "Philosophical Magazine," and in 1838 he established the "Annals of Natural History." His own literary labors, which were principally in the field of Biblical and philological research, comprise an edition of Tooke's "Diversions of Purley" (1829 and 1840), enriched with notes; Warton's "History of English Poetry" (1840), in the reëditing of which he took the chief part; "Taylor's Scientific Memoirs," &c.

**TAYLOR. I. Stephen William**, an American educator, born in Adams, Mass., Oct. 23, 1791, died at Hamilton, N. Y., Jan. 7, 1856. He graduated at Hamilton college, N. Y., in 1817, and became a teacher. From 1838 to 1845 he was professor of mathematics and natural philosophy in Hamilton college (now Madison university), from 1846 to 1851 president of the university of Lewisburg, Pa., and from 1851 till his death president of Madison university, of which he published a historical sketch. **II. Benjamin Franklin**, an American author, son of the preceding, born in Lowville, N. Y., in 1822. He was educated at Madison university. For many years he was literary editor of the Chicago "Evening Journal," and during the civil war he was its principal correspondent with the armies of the west. After the war he settled at La Porte, Ind. He has published "The Attractions of Language" (1845); "January and June," essays and poems (1853); "Pictures in Camp and Field" (1867); "The World on Wheels," railroad sketches (1873); "Old Time Pictures and

Sheaves of Rhyme" (1874); and "Songs of Yesterday" (1875).

**TAYLOR, Thomas**, an English scholar, surnamed the "Platonist," born in London, May 15, 1758, died at Walworth, Nov. 1, 1835. He studied the classics, mathematics, and chemistry, and became clerk in a banking house. He issued, in the course of 40 years, translations of part or the whole of the hymns of Orpheus, the works of Plato (5 vols. 4to), Proclus, Julian, Pausanias, Plotinus, Apuleius, Aristotle, Maximus Tyrius, Demophilus, Iamblichus, Hierocles, Porphyry, Celsus, Ocellus Lucanus, and Olympiodorus, and the "Chaldean Oracles." He also published works on geometry and arithmetic, on the Eleusinian and Bacchic mysteries (new ed., with introduction and notes by Alexander Wilder, M. D., 1875), on "The Rights of Brutes" (in ridicule of Paine's "Rights of Man"), a new edition of Hedericus's "Greek Lexicon" with additions, "History of the Restoration of the Platonic Theology," "Miscellanies in Prose and Verse," &c. His works amounted to 55 vols.

**TAYLOR, Tom**, an English author, born in Sunderland in 1817. He graduated at Trinity college, Cambridge, and became a fellow. He was for two years professor of English literature in University college, London, was called to the bar in 1845, and in 1850 became assistant secretary to the board of health, and in 1854 secretary. Since 1858 he has been secretary to the local government act office. He is the author of more than 100 dramatic pieces, among the most successful of which are "Still Waters Run Deep," "The Unequal Match," "The Overland Route," "The Contested Election," "Our American Cousin," "The Ticket-of-Leave Man," and "'Twixt Axe and Crown." In conjunction with Charles Reade he has written "Masks and Faces" and other plays. He has also published a "Life of Benjamin Robert Haydon" (3 vols. 8vo, 1853); an editorial preface and continuation of the "Autobiographical Recollections of C. R. Leslie" (2 vols. 8vo, 1860); a "Handbook to the Pictures of the International Exhibition of 1862" (8vo, 1862); "Birket Foster's Pictures of English Landscape, engraved by the Brothers Dalziel, with Pictures in Words by Mr. Tom Taylor" (4to, 1862); "Ballads and Songs of Brittany," translated from the French of Villemarque (4to, 1865); and, in conjunction with C. W. Franks, a "Catalogue of the Works of Sir Joshua Reynolds" (8vo, 1869).

**TAYLOR, William Cooke**, an Irish author, born in Youghal, April 16, 1800, died in Dublin, Sept. 12, 1849. He was educated at the university of Dublin, and went to London, where he resided till two years before his death. His chief works are: "Historical Miscellany" (12mo, 1829); "History of France and Normandy" (1830); "History of the Civil Wars in Ireland" (2 vols., 1831); "History of Mohammedanism and its Sects" (1834); "History of Popery" (1837); "The Bible Illustrated from Egyptian Monuments" (1838); "Manual of Modern History" (8vo, 1838); "Manual of Ancient History" (1839); "Natural History of Society" (2 vols., 1840); Romantic Biography of the Age of Elizabeth" (2 vols., 1842); "History of British India" (1842); "Revolutions, Insurrections, and Conspiracies of Europe" (2 vols., 1843); and "Memoirs of the House of Orleans" (3 vols., 1849). He also edited Bacon's essays and Chapman's translation of Homer. In 1846 he was employed by the British government to inquire into the system of education on the continent.

**TAYLOR, William Mackergo**, an American clergyman, born at Kilmarnock, Ayrshire, Scotland, Oct. 23, 1829. He graduated at the university of Glasgow in 1849, studied theology in Edinburgh, was licensed to preach in 1852, and in 1853 was ordained pastor of the United Presbyterian church at Kilmaurs. In 1855 he accepted a call to the United Presbyterian church at Derby road (Bootle), near Liverpool, and remained there for 16 years. In 1871 he visited the United States as a delegate of the United Presbyterian church to the general assembly of the Presbyterian church in the United States at Chicago. In 1872 he became pastor of the Broadway Tabernacle church in New York. He has published "Life Truths" (London, 1862); "The Miracles: Helps to Faith, not Hindrances" (Edinburgh, 1865), written as a reply to Renan's "Life of Jesus;" "The Lost Found and Wanderer Welcomed" (1870); "David, King of Israel" (New York, 1874); and "Elijah the Prophet" (1876).

**TAYLOR, Zachary**, twelfth president of the United States, born in Orange co., Va., Sept. 24, 1784, died in Washington, D. C., July 9, 1850. His father, Col. Richard Taylor, served throughout the revolutionary war, and removed in 1785 from Virginia to Kentucky, where he had an extensive plantation in the neighborhood of Louisville. Zachary was engaged till his 24th year on the plantation. His brother Hancock, a lieutenant in the United States army, died in 1808, and the vacant commission was assigned to Zachary. He was made a captain in November, 1810, and after the declaration of war against Great Britain was placed in command of Fort Harrison, a blockhouse and stockade on the Wabash river, about 50 m. above Vincennes. This was the first object of attack by the Indians, a large force of whom invested it in September, 1812, and after professions of peace made a furious night assault and set fire to the lower buildings of the fort. Taylor had but 50 men, of whom two thirds were ill; but after a sharp conflict of several hours he extinguished the flames and repulsed the assailants with severe loss. For his conduct on this occasion he received from President Madison the rank of major by brevet, the first instance in the service of this species of promotion. A few months later he took part in a successful expedition led by Gen. Hopkins

against the Indian villages, and in 1814, with the full rank of major, commanded an expedition against the British and Indians on Rock river. On the restoration of peace in 1815, congress reduced the army and annulled many of the promotions made during the war. Taylor was reduced to the rank of captain, and in consequence resigned his commission and retired to his plantation near Louisville. Being soon reinstated as major, he was employed for several years alternately on the N. W. frontier and in the south, where in 1822 he built Fort Jesup. In 1819 he became lieutenant colonel, and in 1832 colonel. In the latter year he was engaged in the Black Hawk war, and was then ordered to Prairie du Chien, where he took command of Fort Crawford, which had been erected under his superintendence. In 1836–'40 he served in Florida. On Dec. 25, 1837, he defeated the Indians in the desperate and decisive battle of Okeechobee, and was promoted to the rank of brigadier general by brevet; and in April, 1838, he was made commander-in-chief in Florida. In 1840 he was appointed to the command of the first department of the army in the southwest. He purchased at this time an estate at Baton Rouge, to which he removed his family. Congress having in March, 1845, passed the joint resolution annexing Texas, Gen. Taylor was directed to defend it against invasion from Mexico. In July he embarked at New Orleans with 1,500 troops, and in the beginning of August encamped with them at Corpus Christi, Texas, where he was reënforced, so that in November his forces amounted to about 4,000 men. The administration desired to bring the Mexican question to a crisis, without, if possible, incurring the responsibility of beginning a war. Indirectly, therefore, it endeavored to induce Gen. Taylor to advance his forces into the disputed territory; but he disregarded all hints to that effect, and would not move till explicitly ordered by the president. Positive instructions were at length sent, and on March 8, 1846, the army began its advance toward the Rio Grande, and on the 28th reached the banks of that river opposite Matamoros. Here it encamped and erected Fort Brown, which commanded Matamoros, where the Mexicans were also throwing up batteries and redoubts. On April 12 Gen. Ampudia, the Mexican commander, addressed a note to Gen. Taylor requiring him within 24 hours to break up his camp and retire beyond the Nueces, "while our governments are regulating the pending question in relation to Texas," and informing him that his non-compliance would be regarded by the Mexicans as equivalent to a declaration of war. Gen. Taylor replied that he was acting under instructions which did not permit him to return to the Nueces, and that if the Mexicans saw fit to begin hostilities he should not avoid the conflict. Ampudia was soon after superseded by Arista, who early in May crossed the Rio Grande with 6,000 men, and on the 8th of that month attacked and was defeated by Gen. Taylor with 2,300 men at Palo Alto, a few miles from Matamoros. (See PALO ALTO.) The Mexicans retreated to Resaca de la Palma, and on the following day again gave battle to the Americans, who after a severe contest routed them and drove them across the Rio Grande. The total loss of the Mexicans in these battles amounted to about 1,000 men. Taylor was promoted to the rank of major general, took possession of Matamoros on May 18 without opposition, and remained there till September, when he marched against Monterey, which he reached on Sept. 9 with a force of 6,625 men, mostly volunteers. The place was defended by Ampudia with about 10,000 regular troops. On the 19th Taylor ordered an assault, and after several days' desperate fighting Ampudia capitulated on the 24th. (See MONTEREY.) Taylor made Monterey his headquarters, but occupied with a strong detachment the city of Saltillo, the capital of the state of Coahuila. He was making preparations for an advance upon San Luis Potosí, when the best part of his force was transferred to the expedition against Vera Cruz, under Gen. Scott. He was left with only 5,000 men, of whom but 500 were regulars, the rest being volunteers who had never seen a battle. He received intelligence that Santa Anna had concentrated at San Luis Potosí the flower of the Mexican army to the number of 21,000 veteran troops, and was moving rapidly to attack him in the valley of the Rio Grande. Gen. Taylor on Feb. 21, 1847, took a position at Buena Vista, a mountain pass 7 m. from Saltillo, and awaited the approach of the Mexicans, who made their appearance on the following day, and were signally defeated. (See BUENA VISTA.) Santa Anna retreated to San Luis Potosí, and during the rest of the war the valley of the Rio Grande remained in quiet possession of the Americans. On his return home in November, 1847, "Old Rough and Ready," as his soldiers familiarly called him, was greeted everywhere by the warmest demonstrations of popular applause; and as the time for the presidential election was approaching, his name was at once brought forward for the presidency. He avowed himself "a whig, but not an ultra whig," and in several letters intimated his willingness to accept the nomination provided he could be left untrammelled by partisan pledges, at the same time expressing his distrust of his fitness for the office. In June, 1848, he was nominated by the whig national convention at Philadelphia, the other candidates for the nomination being Mr. Clay, Mr. Webster, and Gen. Scott. Millard Fillmore of New York was nominated for the vice-presidency. Henry Wilson of Massachusetts and a few other delegates, on this result being announced, withdrew from the convention, and subsequently formed the freesoil party on the basis of opposition to the extension of slavery. The democratic national convention had al-

ready nominated Lewis Cass for the presidency; but a powerful section of the New York democracy, familiarly known as barnburners, refused their support to Mr. Cass, partly because of his pro-slavery position. On Aug. 9, 1848, these freesoil democrats assembled in convention at Buffalo, N. Y., together with the freesoil whigs who had rejected the nomination of Gen. Taylor, and the liberty party men who had previously supported James G. Birney. A fusion of these parties was effected on the basis of a platform of which opposition to the extension of slavery was the leading principle, and Martin Van Buren was nominated for president and Charles Francis Adams of Massachusetts for vice president. At the election in November 163 electors were chosen for Taylor and Fillmore to 127 for Cass and Butler. The Van Buren and Adams party did not carry a single elector, their popular vote being about 290,000, while that for Gen. Taylor was about 1,360,000, and that for Cass 1,220,000. Gen. Taylor was inaugurated president on Monday, March 5, 1849, and on the following day appointed as his cabinet John M. Clayton of Delaware, secretary of state; William M. Meredith of Pennsylvania, secretary of the treasury; George W. Crawford of Georgia, secretary of war; William B. Preston of Virginia, secretary of the navy; Thomas Ewing of Ohio, secretary of the interior; Jacob Collamer of Vermont, postmaster general; and Reverdy Johnson of Maryland, attorney general. The democratic party had elected a plurality of the members of congress, and a few freesoil members held the balance of power between the whigs and democrats. A vehement struggle began with regard to the organization of the new territories, the admission of California as a state, and the question of the boundary between Texas and New Mexico, all of these subjects being connected with the question of the extension of slavery. California had applied for admission into the Union with a constitution excluding slavery. There being at this time an equal number of free and slave states in the Union, the proposition to admit California and thus give the free states a preponderance in the senate excited throughout the south the most violent opposition. At the same time New Mexico and Utah, or Deseret, as it was called by the Mormons who occupied it, were without governments. President Taylor in his messages to congress recommended that California should be admitted, and that the other territories should form state constitutions to suit themselves, and should be admitted into the Union with or without slavery as their constitutions might prescribe. These recommendations were not acceptable to the slaveholding leaders, many of whom made open threats of secession. Henry Clay in the senate introduced the compromise measures known by his name, including the recommendations of the president's message. (See CLAY, HENRY.) His propositions were still the subject in one form or another of exciting debates in congress and of earnest discussion among the people, when on the 4th of July, 1850, President Taylor was seized with bilious fever, of which he died on the 9th at the presidential mansion.—Gen. Taylor was of middle stature and stout form, with dark complexion, high forehead, and keen penetrating eyes, with a face more remarkable for intelligence than for elegance, and an expression of much kindness and good nature. It was during this administration that the secession party in the south first manifested itself in considerable force outside of South Carolina. To the schemes of this party Gen. Taylor was sternly opposed.

**TAZEWELL. I.** A S. W. county of Virginia, bordering on West Virginia, and drained by the head streams of Clinch and Holston rivers; area, about 600 sq. m.; pop. in 1870, 10,791, of whom 1,598 were colored. Clinch mountain and other ranges traverse it. The soil of the valleys is very fertile. The chief productions in 1870 were 38,020 bushels of wheat, 155,133 of Indian corn, 69,189 of oats, 9,675 of potatoes, 19,812 lbs. of wool, 95,175 of butter, and 5,301 tons of hay. There were 2,025 horses, 2,562 milch cows, 8,663 other cattle, 9,539 sheep, and 6,651 swine; 3 tanneries, and 3 wool-carding and cloth-dressing establishments. Capital, Tazewell Court House. **II.** A central county of Illinois, bounded N. W. by the Illinois river, intersected by the Mackinaw, and traversed by several railroads; area, 550 sq. m.; pop. in 1870, 27,903. The surface is level, consisting mostly of prairies, and the soil highly fertile. The chief productions in 1870 were 204,827 bushels of wheat, 59,027 of rye, 2,062,053 of Indian corn, 505,841 of oats, 43,210 of barley, 108,984 of potatoes, 29,292 lbs. of wool, 285,323 of butter, and 27,564 tons of hay. There were 10,312 horses, 6,194 milch cows, 10,873 other cattle, 7,591 sheep, and 34,555 swine; 4 manufactories of agricultural implements, 12 of carriages and wagons, 2 of iron castings, 9 of saddlery and harness, 5 of sash, doors, and blinds, 10 flour mills, and 4 distilleries. Capital, Pekin.

**TCHAD,** or **Tsad,** a lake of central Africa, on the borders of Bornoo, Kanem, and Baghirmi, between lat. 12° 30′ and 14° 30′ N., and lon. 13° and 15° 30′ E. It is an irregular triangle, the base of which lies W. S. W. and E. N. E.; length from N. W. to S. E. about 150 m., greatest width about 120 m., area 10,500 sq. m.; but it varies greatly in size in the dry and the rainy season. Its elevation above the level of the sea is about 1,000 ft. It rarely exceeds 15 ft. in depth, and many parts of it are in the dry season a reedy swamp. About two thirds of its area is occupied by islands. Its shores are generally low and flat and covered with rushes and reeds, back of which is fertile ground and rich pasturage; but on the north they rise gradually and are wooded. The S. and W. shores are frequently inundated, and the streets of Kuka, the capital of Bornoo,

which stands about 10 m. from the S. W. shore, are sometimes overflowed. Lake Tchad has two large tributaries, the Komadugu on the west and the Shary on the south, but no known outlet. Dr. Nachtigal says that at some former period the surplus waters were discharged through the Bahr el-Ghazal into an extensive lake 300 m. N. E. The course of this ancient river can still be traced by a fringe of trees, and according to the Arabs water flowed through it for 100 m. during the inundation of 1870. The water of the lake is fresh and sweet; the shallower parts are covered with aquatic plants, and hippopotami, crocodiles, turtles, fish, and water fowl abound. Large herds of antelope feed on its shores, and there are many elephants in the forests on the north. Villages abound on its banks, and the islands in it are densely populated, the central ones by the Buddumas, the eastern by the Kuti, and the northeastern by the Kanembi. The Buddumas are a pagan tribe, distinct from the surrounding Mohammedans. They are well made, active, regular in features, and dark brown or black in complexion. Both sexes are clothed in cotton, and they wear sandals and many ornaments. Cattle and goats are raised by them, and they cultivate maize and cotton.—Lake Tchad was known to Leo Africanus in the 16th century, but the first Europeans who visited it in later times were Denham and Clapperton in 1823. Barth, Overweg, and Vogel explored its vicinity in 1851–'5, Rohlfs in 1866, and Nachtigal in 1870.

**TCHERNIGOV. I.** A S. W. government of Russia, bordering on Mohilev, Smolensk, Orel, Kursk, Poltava, Kiev, and Minsk; area, 20,231 sq. m.; pop. in 1870, 1,659,600. The surface, with the exception of the western portion, is flat, and the soil is particularly fertile. It is well watered, the most important rivers being the Dnieper, which flows on the W. boundary, and its affluent the Desna, which intersects the government. Horses, horned cattle, and sheep are abundant, and the breeds of the first two are particularly good. The manufactures are chiefly articles for domestic use. Much honey, wax, and brandy are produced. **II.** A city, capital of the government, on the Desna, 385 m. S. W. of Moscow; pop. in 1867, 17,096. It is an old town, and has a castle, a beautiful cathedral, several schools, and a large trade.

**TCHIHATCHEFF, Petr,** a Russian traveller, born at Gatchina in 1812. After he had served in the department of foreign affairs and as attaché to the embassy in Constantinople, the government commissioned him to explore the Altai mountains. He has published, besides other works, *Voyage scientifique dans l'Altaï et dans les contrées adjacentes* (Paris, 1846); *L'Asie Mineure: description physique, statistique et archéologique de cette contrée* (8 vols., Paris, 1853–'69); and *Le Bosphore et Constantinople*, of geological interest (1864).

**TCHUKTCHIS. I.** A native tribe of Siberia, inhabiting the E. extremity of the continent of Asia from the 160th meridian to Behring strait. They are apparently akin to the Koriaks, who occupy nearly the same territory, and whose habits and customs are similar. A part of them are settled along the shore, where they support themselves chiefly by killing whales, seals, and walruses; but most of them are nomads, who wander almost constantly with great herds of reindeer, seldom camping more than a week in one place. They are bold, self-reliant, and wholly independent of civilization and government. Their bands are held together only by mutual consent, and have no governing head. In general appearance they are tall, athletic, and vigorous, closely resembling the North American Indians. According to some authorities the Tchuktchis and Koriaks do not number more than 6,000 or 8,000, but the Russian estimates are larger. **II.** A tribe of the Koniaga family in Alaska, otherwise called Aglegmutes, who occupy the coast of Bristol bay from the river Nushagak to lat. 56° N. They live in houses made of slabs, built over an excavation, with a low doorway. They are peaceable, given to labor and trade, and are ingenious in carving and other work, but are sunk in vices and extremely filthy.

**TEA** (Chinese, *tcha*, *cha*, or *tha*), a substance used in making a beverage by infusion, consisting of the dried leaves of one or more species of plants of the old genus *thea*. Bentham and Hooker, who have thoroughly revised the genera, say (*Genera Plantarum*, vol. i., p. 187) that they can find no good characters by which to separate *thea* as a genus distinct from *ca-*

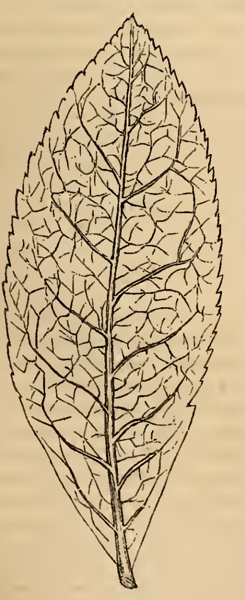
Tea Plant (Camellia thea).

*mellia;* as botanists were mostly agreed that there was but one species of *thea*, the botanical name of the tea plant under this arrangement will be *camellia thea*. The genus is well known from the very general cultivation of *C. Japonica* and other species, especially their double forms, in greenhouses in the northern states, and in the open air in the southern. The tea species differs from any of these in having longer, narrower, thinner, more serrate, and less shiny leaves; its flowers are axillary and nodding, and, though only about an inch across, closely resemble those of a single camellia.

The sepals and petals are usually five, the stamens numerous, a portion forming by their united bases a cup within which are numerous separate stamens; the fruit or pod is usually three-celled, with a single large seed in each cell. The plant in the wild state is a bushy shrub, and sometimes a small tree, but in cultivation is kept dwarf by pruning. Like other plants long in cultivation, tea has produced several marked varieties, which have been described as distinct species. The original country of tea is not known; it has been found in a truly wild state in Assam. In the East it may be cultivated through a wide range, from India to Japan. In this country the plant barely survives the winter at Washington, but a little south of that city it succeeds, and in North Carolina and Georgia bears fruit abundantly. On the Pacific coast, where the climate is especially favorable for broad-leaved evergreens, both native and exotic, the tea plant flourishes much further north than at the east. The time of its first cultivation in China is not known. That its use in the Indies is comparatively recent is inferred from the fact that there is no name for the plant or its product in the Sanskrit. The Portuguese are said to have been the first to import tea into Europe, and were acquainted with it early in the 16th century; early in the 17th it was introduced by the Dutch. Previous to that time it was the custom among European nations to make use of hot infusions of various leaves, notably those of the sage (*salvia*), which at one time had a high reputation, and was regarded as a sort of panacea; its dried leaves were taken to China by the Dutch East India company, to be exchanged for the tea leaf. About the middle of the 17th century a Russian embassy to China brought back to Moscow packages of tea, which were received with much favor; and in 1664 it is recorded that the English East India company made the queen of England what was considered the brilliant present of two pounds of tea. When first introduced into England, tea sold by the pound at £6 to £10; it was known there previous to its direct introduction, having been brought from Holland, but was only used on rare occasions. The first considerable importation was in 1667, when the East India company brought in 4,713 lbs., which was a supply for several years.—Teas are classed as black and green, distinctions not due to their production by different species, but to the age of the leaf when gathered and the methods of preparation; each of these has several subvarieties named from the provinces producing them or the points of exportation, or some peculiarity in the article itself. The Chinese districts which supply the export demand lie between lat. 25° and 31° N. Tea has long been in cultivation in Japan, and since the opening of that country to commerce a large trade in it has grown up. Various parts of India are eminently favorable to the culture; the government of British India has encouraged the introduction of the Chinese plant, and also the cultivation of that found wild in Assam, and large supplies are sent from India to England. In Java and Penang the culture has been established with favorable results. About 1850 the plant was introduced into Brazil, and by the aid of Chinese laborers some tea was produced; but little mention has been made of the results in later years. The experiments in cultivating tea in the United States have been numerous; the most noted was that of Dr. Junius Smith of Greenville, S. C., who gave in the reports of the United States patent office from 1848 to 1859 full accounts of his results; his labors and those of others show that there are localities in the southern states well adapted to the production of excellent tea, and that its success in this country is only a question of the price of labor. In California, where the plant flourishes admirably, an experiment in tea culture has recently been undertaken by a colony of Japanese.—While the many varieties of tea are no doubt produced by the same species, the quality of the product being largely determined by the preparation given to the leaves, it is also much influenced by the soils and situations in which the plants grow. The tea of the hills is different from that of the low lands, and that which receives but little care gives a product inferior to the highly cultivated. The slopes of the hills are preferred, at an elevation depending upon the climate; almost any good arable soil, free from stagnant moisture, will serve for the culture. In China the plant blooms in November, and the seeds are ripe by the next autumn; these, kept in sand till the following spring, are sown in a seed bed, or in rows where the plants are to grow; the plants stand 4 or 5 ft. apart each way, and when about 18 in. high have the leading shoots pinched to induce them to become bushy. The plants yield a small picking in their third year, and attain their maximum yield in the eighth or tenth, after which they deteriorate and give way to young plants; in some localities the land is enriched with litter, sewage, or other fertilizers; the plant, which would naturally form a tree, is, for the convenience of picking, kept pruned down to 5 ft. The quality of the tea depends largely upon the age of the leaves at the time of picking; the younger the leaves the more delicate their flavor, and of course the smaller the yield. The earliest picking, the first of April, consists of the buds and the very youngest leaves; a second gathering, at the end of April or early in May, consists of more developed leaves, and is the most important crop; an inferior quality of leaf is gathered in July, and in some localities another picking of old and poor leaves is made still later. The picker has a basket slung by a cord around his neck, to leave both hands at liberty; he holds the shoot with one hand, and breaks off the blade of the leaf with the other, for, except in the earliest picking of the very

young leaves, no portion of the petiole or leaf stalk must be gathered with the finer kinds of tea. If left in large masses, so that heating or natural fermentation takes place, the leaves are greatly injured. The manipulations to which they are subjected vary greatly, and are often prolonged and repeated in various ways. As each locality has its traditional treatment, supposed to be necessary, the accounts of the process vary greatly; in all, however, the first step is to prevent the fermentation of the leaves, by exposing them in shallow baskets to the sun and air, which withers and slightly dries them. They are then placed in small quantities in a shallow copper or iron pan heated by charcoal or other fuel, and rapidly stirred; at the proper moment they are swept out into other vessels or upon a table, where other workmen rub the leaves between their hands in order to roll them into the form which they finally retain; exposure to the air and a final heating complete the process with some teas, while with others there are several heatings, alternated with airings; the choicer teas are spread out upon a table to be assorted before packing, all imperfectly rolled leaves being removed and the dust and fine fragments sifted out. The chest with its leaden lining being ready, one bare-footed laborer gets into it, and another gradually pours in the leaves, which the first treads down firmly, and as soon as the case is full the leaden cover is soldered down. If the process of drying is completed as rapidly as possible after picking, the tea remains green; but for black tea the process is prolonged, and repeated with long intervals of exposure, sometimes for a whole night, in order that a kind of fermentation may take place. Sometimes two qualities are made from the same picking by sifting the finer leaves from the coarser after they are dried. Apart from the tedious labor of picking the crop leaf by leaf, the necessity for these many small operations before the tea is ready for use will prevent its successful culture in this country, where the cost of labor is already a serious problem in the cultivation of the ordinary farm crops. It requires about 4 lbs. of fresh leaves to make 1 lb. of dried tea, and the yield per acre is from 300 to 400 lbs. Certain districts in China produce either green or black tea exclusively. A third sort, the scented teas, is recognized in commerce. The scenting is generally due to the admixture of certain flowers, and while it is sometimes practised upon choice kinds, it is more frequently employed to give inferior kinds a better flavor; the principal flowers used are those of tea-olive, *olea* (or *osmanthus*) *fragrans* (see Olive), and the chulan (*chloranthus inconspicuus*); but those of the cape jasmine (*Gardenia*) are sometimes employed. The flowers are laid with the leaves under pressure, or are dried with them and afterward sifted out. The classes of tea are subdivided, and names, not always permanent, are given to subvarieties founded upon the size and age at which the leaf is picked. Of the Chinese teas, the principal black sorts are bohea, congou, souchong, caper, oolong, pekoe, and others. Bohea is the coarsest of these, and its importation has greatly fallen off of late years. The highest quality of black tea is pekoe, which consists of the very youngest leaves of the first picking; these, when so young that they are still clothed with down, constitute the flowery pekoe. Among the green teas are twankay, hyson skin, young hyson, hyson, imperial, and gunpowder. The gunpowder in green tea corresponds with the pekoe in black, and like that is from the first gatherings; imperial, hyson, and young hyson are grades made from the second and third pickings, while the inferior light leaves, winnowed from the hysons, make the hyson skin, the chief market for which is found in this country. The brick tea of Thibet is probably the poorest of all; it gets its name from the shape of the blocks into which refuse tea and tea sweepings are made by mixing them with bullock's blood and drying by fire heat; the bricks are wrapped in paper or sewed up in sheep skins, and are rarely exported except as a curiosity. The teas from India have a separate nomenclature. The finer teas, both black and green, are rarely seen in this country; if packed in large parcels, or conveyed in the hold of a ship, a fermentation or change takes place which destroys their quality; a large share of the crop is consumed by the wealthy Chinese, and a portion of it finds its way by overland conveyance to Russia. —Teas are subject to various adulterations in China, and in the countries where they are sold, including the mixing of different qualities, and the coloring and other treatment to improve the looks of inferior kinds. The manipulation of poor teas to give them a finer appearance is carried on in China, and there are establishments in both England and America engaged in the business. The glazing or facing of teas is done with plumbago or black lead, added in fine powder to the tea in a revolving cylinder where the mutual attrition imparts to the leaves a peculiarly smooth and glossy appearance. Green teas, being in this country especially popular (their higher price conveying the idea that they are of better quality), are produced to meet the demand by coloring cheaper black kinds. The principal materials used in coloring are "China clay," or terra alba (largely found in this country and exported), Prussian blue, and turmeric; sometimes gypsum and indigo are used; the coloring matters, mixed in proportions to produce the desired shade, are added to the slightly moistened tea, and the whole agitated until the color becomes evenly distributed and the leaves by rubbing together become glazed. This treatment, with variations in the manipulation, is so general that but very little uncolored green tea is offered for sale. The coloring and facing are readily detected by examining the leaves under the microscope as an opaque

object, when the particles of coloring matter are easily seen; if it is desired to make a further examination as to the materials used, the leaves must be treated with water, and the washings subjected to chemical tests, or be burned, and an analysis made of the ash. The adulteration by mixing a finer tea with a portion of an inferior grade is common; besides this the Chinese prepare what is called "lie tea" for this express use, consisting of the dust which accumulates in the manufacture of tea, and the dust of other leaves, rice husks, &c., made up by the aid of gum into little pellets and colored to resemble tea. Some years ago the annual importation of this stuff into England was half a million pounds annually, all of which was used to mix with teas. The adulteration is readily detected by soaking a portion of tea and examining it with a lens; the true leaf may be unrolled and spread out, while the factitious article will separate into its component fragments. Another adulteration is with exhausted tea leaves; at the Chinese tea houses, which are open day and night, the tea is usually made in a cup, covered with a saucer, and then poured into another cup; large jars stand about the saloons into which the dregs are emptied; these are carefully made over and find their way into commerce. The detection of these when colored is not difficult, but when they are rerolled without coloring, a chemical analysis must be made; it is generally only necessary to test for the amount of tannic acid, which in genuine teas ranges from 20 to 40 per cent., while in exhausted teas it is from 7 to less than 1 per cent., and sometimes completely extracted. The adulteration with other leaves is practised in China, and was formerly to a large extent in England; willow leaves and those of *camellia sasanqua* are much used in China, while in England those of the sloe or wild plum, the hawthorn, elder, plane tree, poplar, and others have been employed. These adulterations and others with false leaves may be readily detected by soaking out and unrolling them; those of the true tea being well known as to their shape, the character of the margin, and especially the serration (the looping together of the principal veins just within the margin being very characteristic), they may be readily picked out from any foreign admixture by the aid of a hand glass.—Tea has been analyzed by different chemists, whose results show much discrepancy, doubtless due to the variable character of the product. The average composition is, in 100 parts: carbohydrates (gum and sugar), 21; fatty matters, 4; albuminoids, 15; tannin, 26·23; vegetable fibre, 20; theine, 2 or 3; mineral substances, 5; water, 5; and an aromatic oil, less than 1. The most important constituent is theine, or, as it is identical with the active principle in coffee, caffeine, a crystallizable substance, soluble in water and having a bitter taste (see CAFFEINE); acting as a feeble base, it is classed among the alkaloids, with the formula $C_{16}H_{10}N_4O_2+H_2O$. Some give the proportion as high as 6 per cent. in the finer green teas, but the average is 2 to 3 per cent. The constituent next in importance is the aromatic oil, as upon this depends the aroma and a large share of the flavor of the tea. The tannin gives the tea its astringency; in the proper making or infusing of tea the object is to extract as much of the theine and aromatic oil and as little of the tannin as possible; when tea is infused too long, or is boiled, the amount of tannin in the infusion is perceived by its marked astringency; more or less of the other constituents are taken up by the water, and give what is called "body" to the tea.—The wealthy Chinese make their tea in the cup. The proper quantity of leaves is placed in the cup, boiling water poured over them, and the cup covered for a time with the saucer; to prevent the leaves from rising to the surface, a perforated bit of silver, or silver filigree work, is placed over them. The poorer Chinese make their tea in a tea pot. In Japan some teas are reduced to a fine powder, which is infused in the cup and stirred before taking, that both the infusion and powder may be swallowed; it is also the custom in Tartary to take the leaves with the liquid. In other countries it is customary to make some addition to the tea: in England and America, sugar and milk or cream; in Russia, lemon juice; and on the continent of Europe it is very common to add a little brandy or other spirit. The quality of the tea (the infusion) is greatly affected by the manner of making it. Those who think that color indicates strength boil the tea, either putting the leaves directly into boiling water, or placing them in cold water and setting the pot upon the fire until the water boils; some practise prolonged infusion, with the same result, a dark-colored liquid, in which the proper flavor is concealed by the amount of tannin extracted; and some add a fragment of soda to increase the color. Connoisseurs in tea usually make it on the table, a caddy containing several kinds of tea and an urn of boiling water being at hand; a portion of boiling water is poured into the tea pot, and when that is thoroughly warmed the water is distributed among the tea cups; then the leaves of one sort (or a



Tea Leaf.

mixture of two or three sorts) are placed in the pot, boiling water poured on, and in a few minutes, the cups being emptied of the water put in to warm them, it is served. The character of the water greatly influences the quality of the tea, it being impossible to make really good tea with hard water. Excess of lime in the water may be corrected by the judicious use of carbonate of soda.—The effects of the habitual use of tea have been much discussed, some regarding them as highly deleterious, while others, on account of the large proportion of nitrogen in theine, have maintained that tea is nutritious, and serves as a substitute for food. The elaborate experiments of Dr. Edward Smith ("Foods," in the "International Scientific Series," New York, 1873) are worthy of study; his results in brief are: that while the amount of nutriment contained in the quantity of tea one consumes is not sufficient to be of use in building up the system or in supplying heat, it has a marked effect upon the vital functions, and particularly stimulates respiration, as shown by the increased amount of carbonic acid thrown off by the lungs after taking it; and that it powerfully promotes the assimilation and transformation of other foods. Excessive use of tea produces wakefulness and increased mental and bodily activity, which is followed by a reaction that brings exhaustion and a corresponding depression. Most of the unpleasant effects of tea are ascribed to the volatile oil; the long continued breathing of air impregnated with this produces illness in the packers of tea, and the tea tasters at the tea marts in China, who are even careful not to swallow the infusion, are obliged in a few years to give up their lucrative positions with shattered constitutions. The Chinese, who drink tea at all times, are careful to use none less than a year old, as in time the oil either evaporates or is so modified that it ceases to be injurious.—There are numerous substitutes for tea in different countries, and widely separated peoples have in use some plant the active principle of which is closely analogous to, if not identical with, that in tea. Besides coffee and chocolate, one of the most important of these beverages is the Paraguay tea. (See MATÉ.) The *khat* of Arabia and Abyssinia, introduced into the Mohammedan parts of Africa, is *catha edulis*, the leaves and small twigs of which possess the properties of tea in an eminent degree. The coca of Peru and Bolivia, though generally chewed, has similar properties, and is sometimes used like tea. (See COCA.) Other plants might be cited. (See also NEW JERSEY TEA.) —The official records of importation into England begin in 1725, in which year there was imported 370,323 lbs.; in the first year of the present century the quantity entered for home consumption was 23,730,150 lbs. Until 1834 the East India company had a monopoly of tea, which paid a heavy duty; but in that year the duty was reduced, and the trade thrown open to all. The imports of tea into Great Britain and Ireland for five years, ending Dec. 31, entered for home consumption only, were: 1869, 998,995 cwt.; 1870, 1,050,202; 1871, 1,102,943; 1872, 1,141,003; 1873, 1,178,760. The value of the total import for the same years, of which one fourth was reëxported, was £10,311,465, £10,097,619, £11,635,644, £12,933,143, and £11,372,595. The imports into the United States for five years, ending June 30, for home consumption, were: 1869–'70, 423,293 cwt.; 1870–'71, 458,615; 1871–'2, 569,741; 1872–'3, 578,707; 1873–'4, 498,318. The total values (in gold) for the respective years were $13,871,546, $17,254,617, $22,943,575, $24,466,170, and $21,212,334.

**TEACHERS' INSTITUTE,** in the United States, an assemblage of the teachers of the public schools of a county or part of a county for the purpose of receiving instruction in the art and methods of teaching, by lectures, conferences, class drills, &c., from experienced teachers. An institute is usually held in each county under the supervision of the county superintendent of schools once a year, sometimes oftener, the sessions lasting from one to two weeks. The instruction is free. This plan was first adopted by Henry Barnard, state superintendent of schools in Connecticut, in 1839. Institutes have been held in New York since 1843, and have been maintained by state appropriations since 1847. They were begun in Massachusetts and Rhode Island in 1845, and soon afterward in many other states. In most of the states they are required by law to be held, and in several the attendance of teachers is obligatory. In some states provision is made for their maintenance by public funds. The instruction in these temporary training schools is necessarily almost wholly oral, and is confined to an explanation and illustration of the best methods of teaching and governing schools. Conferences are held, in which the teachers relate their own experience of particular methods of instruction and discipline.

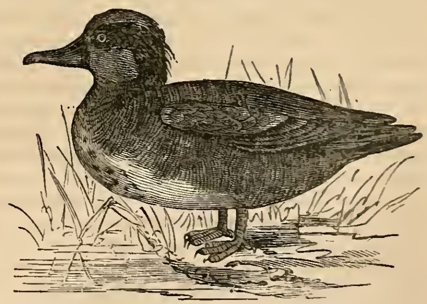
**TEAK,** an East Indian tree, *tectona grandis* (called in Malabar *tecca*), valuable for its timber. It belongs to the *verbenaceæ*, a family which, while its most familiar representatives with us are ornamental herbs and shrubs, includes some important tropical trees. The teak is remarkable for its size and beauty; it grows over 200 ft. high; the elliptical leaves are 12 to 24 in. long, and so rough as to be useful for polishing wood; the small white flowers are fragrant, in terminal panicles, and have the structure common to the family. The tree is found in various parts of India and the adjacent islands, and has been introduced into other British possessions. It is probable that other and closely related species contribute to the supply of commerce. The wood of the teak is one of the most remarkable known on account of its great weight, hardness, and durability, qualities which have caused it to be long used in

the East, not only for temples, but for dwellings. It is most employed in ship building, being practically indestructible by wear or decay, and vessels built of it have lasted 100

Teak (Tectona grandis).

years, to be then only broken up on account of their poor sailing qualities from faulty models. The wood works easily, but on account of the large amount of silex contained in it, the tools employed are quickly worn away; it is brownish, and contains an oil which prevents spikes and other iron work with which it is in contact from rusting, even when the wood is used green. Its weight varies in different localities, from 42 to 52 lbs. to the cubic foot; the teak from Malabar is the heaviest, while that from Burmah and Siam is much lighter; in ship building its great weight largely offsets its durability, and it is therefore now customary to use it only for planking.—Various similar woods are called teak; the African teak was long used in ship building before its origin was known; it is the genus *Oldfieldia*, of the euphorbia family.

**TEAL,** the common name of the small river ducks of the genera *nettion* (Kaup) and *querquedula* (Stephens), called *sarcelles* by the French. In the genus *nettion* the bill is as long as the head, straight, unusually narrow, with sides parallel, as high as broad at the base, the depressed tip with a very narrow nail; wings moderate and pointed, second quill the longest, and the secondaries lengthened and pointed; tail moderate and wedge-shaped; toes united by a full web, the hind one short and slighty lobed. There are about 20 species, distributed all over the globe, though most numerous in the northern hemisphere; they are migratory, commencing their rapid flights in small flocks soon after sunset, resting by day on the surface of fresh water or the reedy shores of rivers and lakes, and feeding principally at night on aquatic insects and worms, seeds, and grains; the nest is made of a large mass of decayed vegetable matter lined with down, and the eggs are eight to ten; they are highly esteemed as game. The European teal was domesticated by the Romans. The green-winged teal (*N. Carolinensis*, Baird) is 14 in. long, 22 to 24 in. in alar extent, and the bill $1\frac{3}{8}$ in.; the head and neck are chestnut, the chin black, and the forehead dusky; around the eyes and on the sides of the head is a broad rich green stripe, passing into a bluish black patch on the nape; below white, with rounded black spots on throat; lower neck, sides, and scapulars finely banded with black and grayish white; speculum on wings broad and rich green; a white crescent in front of bend of wings; under tail coverts black, with a patch of buff white on each side; wing coverts plain olive-gray; in the female the under parts are white, and the upper dark brown with gray edgings. It occurs over the whole of North America, and accidentally in Europe; it migrates principally over the land, breeding from the great lakes to the fur countries; it runs well, is a good swimmer and diver, and a very rapid and graceful flier; having a comparatively long neck, it feeds while swimming, and, being choice in its selection of food, affords a delicious flesh; it is not very shy; the eggs are $1\frac{3}{4}$ by $1\frac{3}{8}$ in., much rounded, dull yellowish with indistinct deeper tints.—In the genus *querquedula* the bill widens a little to the end, which is obtusely rounded, is higher than broad at base, has a wider nail and the lamellæ visible on the sides. There are about half a dozen species in North America, Europe, and Asia,



Green-winged Teal (Nettion Carolinensis).

with habits similar to those of the other genus. The blue-winged teal (*Q. discors*, Steph.) is 16 in. long, 24 or 25 in. in alar extent, with a bill of $1\frac{7}{8}$ in.; the head and neck above are plumbeous gray; top of head black; white crescent in front of eyes; under parts purplish gray, each feather spotted with black; fore part of back brownish with two narrow bands of purplish gray; back behind and tail greenish brown; under tail coverts black; outer webs of some of the scapulars and the wing coverts bright blue; greater coverts tipped with white, with grass-green speculum below them; bill black; in the female the top of the head is brown, chin and throat yellowish white, back brown with paler edgings, under parts whitish

with obscure brown spots, and the same blue and white in the wings as in the male. It is found throughout eastern North America to the Rocky mountains, is abundant about the mouths of the Mississippi in winter, and is less hardy than the green-winged species.

**TEARS,** the limpid, colorless, slightly saline secretion of the lachrymal glands, continually poured out in quantity sufficient to bathe the surface of the eyes, to secure the easy and free motion of the lids, and to wash off any irritating particles from their sensitive membrane. The lachrymal belong to the aggregated glands, or those in which the vesicles or *acini* are arranged in lobules; there is one at the upper, external, and anterior part of each orbit, in a depression of the frontal bone, in relation with the external rectus muscle, resting behind on a fatty areolar tissue; each gland is of the size of a small almond, reddish white, flattened, and enveloped in a fibro-cellular capsule; the secretion is poured out by six or seven trunks opening within the upper lid. At the inner angle of the eyes, in both lids, are two very narrow, always open apertures, the lachrymal *puncta*, in the middle of a slightly prominent tubercle, about 1½ line from the inner junction of the lids; they are opposite each other, the lower turned up and the upper down, and both outward and backward. Through these openings the tears are conveyed by the lachrymal ducts in each lid to the lachrymal sac, at the inner angle of each eye, in the bony groove between the lachrymal bone and the ascending process of the superior maxillary; it is a small membranous sac, opening below into the nasal duct, which conveys the tears into the nose beneath the inferior turbinated bone. At the inner angle of the lids, in front of the globe and behind the lachrymal puncta, is a small reddish tubercle, pyramidal, with the summit turned forward and outward; this is the lachrymal caruncle, and consists of a mass of small mucous follicles, covered by the conjunctiva, which forms in front and to the outside a semilunar fold, called the nictitating membrane; this is rudimentary in man, but remarkably developed in birds. The act of crying, generally accompanying an increased secretion of tears, as far as the movements of respiration are concerned, is very nearly the same as that of laughing, though occasioned by a contrary emotion; the expiratory muscles are in more or less violent convulsive movement, sending out the breath in a series of jerks, accompanied by well known sounds; in children the act is sometimes continued almost to the complete emptying of the chest of air, to the great dismay of parents, but the necessity of breathing is always stronger than the convulsive muscular movements. Moderate excitement, whether of joy, tenderness, or grief, increases greatly the quantity of the tears, though the secretion is checked by violent emotions; in intense grief the tears do not flow, the restoration of the secretion being a sign of moderated sorrow, and itself affording relief by the resumption of nervous action. The sensory, emotional, or instinctive ganglia, situated at the base of the brain, to a certain extent independent of the will, in intense grief become congested, and the flow of tears is the natural method for their relief; hence the danger of cerebral disturbance from long continued tearless grief. Considering their size, there are no other glands which ordinarily can so increase the amount of their secretion as the lachrymal; the quantity is sometimes very great, and very easily stimulated; the shedding of tears is also contagious.—The lachrymal puncta may be closed, causing the tears to flow over the cheeks, for which the remedy is dilatation by fine probes. When the nasal duct is obstructed, the eye is watery and the corresponding nostril dry, the sac forming a small tumor at the side of the nose; the sac also may be inflamed, with pain, tenderness, swelling, and feverish symptoms; this may end in suppuration, and an external opening, constituting lachrymal fistula, requiring the restoration of the obliterated duct by styles of different materials.

**TEASEL** (A. S. *tæsel*, from *tæsan*, to tease), the ripened flower heads of *dipsacus fullonum*, used for raising a nap upon woollen cloths. The genus *dipsacus* (Gr. διψῆν, to thirst, supposed to refer to the cups formed by the united leaves in some species, which hold water) is the representative of a small family, the *dipsaceæ*, which is so closely related to the *compositæ* that in a systematic arrangement it is placed next to that family. Like the composites, the teasel family have their flowers in dense heads, but their anthers are not united and the seeds have albumen. In the teasel itself, of which there are about a dozen old-world species, the plants are biennial or perennial, with coarse, deeply toothed, opposite, rough leaves; the branches are terminated by an oblong head, consisting of small flowers, each in the axil of a bract, which appears as a strong scale when the seeds are ripe. The wild teasel (*D. sylvestris*) is sparingly introduced, and is found in the older states as a roadside weed; it is from 2 to 6 ft. high, and its numerous heads of pale purple flowers, with a large involucre at their base, make it a conspicuous and not inelegant plant; the bracts to the heads terminate in a long straight point; it should be treated as an intruder. The teasel of commerce, or fullers' teasel, though bearing the specific name given above, is generally supposed to have originated from the wild teasel, from which it differs in having a longer head with a shorter involucre; the bracts are much stiffer, and have hooked points. These heads, when ripe, are about 2½ in. long and 1½ in. in diameter, and clothed with regular, strong, sharp, recurved hooks; they are an important article of commerce, and in some countries of cultivation; considerable quantities are produced in England, but the chief supply is from Holland and France. The teasel has now and then been cultivated in

this country; any good soil suits it; the seed is sown in spring, the plants thinned to 18 in. and kept cultivated through the season; the next year the flower heads appear, and earth

Wild Teasel (Dipsacus sylvestris), and Head of Fullers' Teasel.

is thrown against the plants to keep them upright; when the flowers wither, the heads are cut, leaving 8 or 9 in. of stalk attached, and dried in the sun. Their use is to tease or raise a nap upon cloth, and this is done by the hooks, which catch and pull out one end of the wool fibres, near the surface, leaving the other end of the fibre still twisted in the thread. Formerly teasing, or teasling, was done by hand, the heads being fastened in a frame, and drawn over the surface of the cloth by the operator with a frame in each hand; now the work is done by machinery; the teasels, cut lengthwise into halves or quarters, are attached to a wooden cylindrical frame, which revolves, while at the same time the cloth passes beneath it. Much inventive talent has been expended in providing substitutes for teasels, but all have been discarded; for the natural teasel, unlike any artificial substitute, while sufficiently strong to perform the required work, will yield or break in contact with a knot or other obstacle, without injury to the cloth.

**TECHNOLOGY** (Gr. τεχνή, an art, and λόγος, discourse), the systematic knowledge of the theory and practice of the industrial arts. It is divisible into several branches, but chiefly into chemical technology and mechanical technology. Chemical technology embraces those industries which chiefly demand a knowledge of chemistry, such as the manufacture of chemicals, including the various acids and the compounds of soda and potash; the manufacture of soap and candles, glass, and the various kinds of pottery and porcelain; the manufacture of illuminating gas, and the distillation and refining of the waste products of gas works and of crude petroleum; and the distillation and rectification of spirits and the fermentation of wine and beer. Mechanical technology embraces textile manufactures and the mechanic arts in general. In many of the arts a combination of both mechanical and chemical knowledge is required, as in glass making and calico printing. Schools of technology are established independently and also in connection with colleges and universities, not only for the advantage of the general student, but for those who intend to become experts in one or at most a few branches, in which the fundamental principles of the arts are taught, including mathematics, mechanical engineering, natural philosophy, chemistry, and usually mineralogy and geology. In independent institutions other branches are added.

**TECUMSEH**, or **Tecumtha**, a chief of the Shawnee Indians, born near the present town of Springfield, Ohio, about 1768, killed at the battle of the Thames, Oct. 5, 1813. His first prominent appearance was in the attack on Fort Recovery in 1794. About 1805 his brother Elskwatawa set up as a prophet, denouncing the use of liquors, and of all food and manners introduced by the whites. Tecumseh and the prophet then attempted to unite all the western tribes into one nation to resist the whites. They visited the Indians from the lakes to the gulf of Mexico, and soon had a village of 400 Indians gathered at Greenville. Gen. Harrison required them to remove, as it was beyond the Indian limit fixed by treaty. Tecumseh went to Vincennes with 400 warriors to overawe Harrison, and the conference was broken up by his violence. Finding that he had gone too far, he attempted to explain. In 1811, while he was in the south exciting the Creeks and Seminoles to rise by promise of English aid, Harrison marched on the prophet's town to demand that the Indians should return to their various tribes, murderers of whites be surrendered, and plunder given up. The prophet attacked him, and was defeated at Tippecanoe, on the Wabash (Nov. 7). This disconcerted Tecumseh's plans and broke the spell of the prophet's power. When war was declared with England, Tecumseh appeared in Canada with a number of warriors, and refused to meet the American commanders in council. He was in the action against Van Horne on the Raisin, and after being wounded at Maguaga was made a brigadier general in the British forces. He was in command with Proctor at the siege of Fort Meigs, and saved American prisoners from massacre. After the battle of Lake Erie he urged Proctor to engage Harrison when he landed, but accompanied him in his retreat. In the first engagement he was wounded while holding the passage of a stream. With Proctor he selected the battle ground at the Thames, in the S. W. corner of Canada, and he commanded the right wing. Laying aside his sword and uniform in the conviction that he must fall, he put on his hunting dress and

fought desperately till he was killed. Col. R. M. Johnson was said to have shot him; but in reality his death was not for some days known to the Americans.—The life of Tecumseh and of his brother the prophet has been written by Benjamin Drake (12mo, Cincinnati, 1841).

**TEETH**, the organs in vertebrates for the seizure and mastication of food, placed at or near the entrance to the alimentary canal. In adult man there are 32, 16 in each jaw, implanted in sockets, and of an irregular conoid form; in the child, previous to the second dentition, there are only 20. For their development see DENTITION. The number of the teeth increases in the lower animals, being greatest in the cetaceans and marsupials among mammals, and also considerable in many reptiles and fishes. The portion of a tooth above the socket is called the crown, the concealed part the root or fang; between these there is a more or less marked constriction or neck. In vertebrate animals the teeth, like the bones, have for their earthy basis phosphate of lime, mingled with some carbonate of lime and a certain proportion of fluoride of calcium. The latter substance is more abundant in the enamel of the teeth than elsewhere, but everywhere phosphate of lime is the main ingredient upon which the teeth depend for their solidity and firmness.—A tooth is composed of three different tissues, dentine, *crusta petrosa*, and enamel. The dentine, forming the greater part of the body of the tooth, consists of a firm, transparent, nearly homogeneous substratum, composed of about 72 per cent. of calcareous matter and 28 per cent. of organic substance. It is permeated throughout by minute cylindrical channels, called *canaliculi*, about $\frac{1}{12,000}$ of an inch in diameter, which radiate from a central cavity contained in the tooth, called the pulp cavity, toward the external surface of the dentine. During their course the canaliculi branch and divide, often several times in succession, becoming thus very much reduced in size and at the same time increased in number. In the central cavity of the dentine is contained the pulp of the tooth, a soft, vascular, and sensitive papilla, the only portion of the tooth which is supplied with blood vessels and nerves. Undoubtedly the canaliculi of the dentine are either channels for the absorption of nutritious fluids from the pulp, or are filled with soft filaments composed of organic material, by which this absorption is accomplished. The crusta petrosa is a thin layer of bony tissue attached to the outside of the dentine in the fang of the tooth, and serving to connect it, by means of its periosteum, more firmly to the socket. It differs but little from compact bony tissue elsewhere, except that it contains no blood vessels, and is distinguished only by the presence of the irregularly shaped bone corpuscles, which are connected by their radiating filaments with the extremities of the canaliculi of the dentine. The enamel, which covers the surface of the crown of the tooth, is much the hardest of its tissues, containing often over 95 per cent. of calcareous matter. It appears to consist of superimposed layers of calcified epithelium, and is well adapted, by its extreme solidity and almost crystalline texture, to endure the attrition of foreign substances without disintegration.—Three kinds of teeth are distinguishable in mammals, viz., incisors, canines, and molars. The incisors are in the front and median portion of the jaws, and have a simple flattened root and a thin cutting edge, suitable for dividing and collecting food, as in the jaws of the beaver and squirrel and in the lower jaw of the ox. The canines, four in number, are next to the incisors, separated from them by an interval, except in man; the crown is conical, and the root long and simple. They are the so-called eye and stomach teeth in man, and form a striking characteristic and formidable weapons in the carnivora; they are best adapted for securing and tearing living prey. The molar teeth are the most posterior, and have flattened and tuberculous crowns suited for grinding down vegetable food; they are most developed in herbivorous animals; the roots in man are often much bifurcated, rendering extraction difficult.—Teeth are so intimately related to the food and habits of animals, so easily examined, and of such indestructible materials, that they are of the first importance in the classification of animals, both living and fossil. When fully formed they are subject to decay, but have no inherent power of reparation; they may increase by abnormal growth of the crusta petrosa, their most highly organized constituent. For the diseases and the mode of treatment of the teeth, see DENTISTRY.—In fishes the teeth vary from none in the sturgeon and lophobranchs to countless numbers in the pike and the siluroids. They are usually conical, but sometimes flattened or pavement-like, villiform, serrated, and cutting; they may be situated on any of the bones of the oral cavity, on the tongue, and in the pharynx; in most cases they are firmly united to the jaws by continuous ossification, but in some are movable; they are composed of dentine and its modifications, enamel occurring in only a few cases, like the parrot fish (*scarus*); and they are frequently shed and renewed, the germs being developed from the free surface of the buccal membrane. Among reptiles, the whole order of chelonians (tortoises and turtles), and also the toad family among batrachians, are without teeth. In the others these organs are usually simple, and adapted for seizing and holding but not chewing their food; the number is never so small nor so large as in fishes, and is rarely characteristic of species. They are generally conical, sharp, and smooth, and may be placed on any of the bones entering into the structure of the mouth; the base never branches into diverging fangs, and in most is anchylosed in various ways to the bone which bears them, as noticed

under the different families; dentine and cement are always present, and sometimes enamel, as in the saurian crown. Among mammals, some of the edentates, as ant-eaters and pangolins, have no teeth; in the others they are implanted in sockets, and the molars have two or more roots when they have a limited growth; they are confined to the superior, inferior, and intermaxillary bones, a single row in each. Mammals have been divided by Owen into monophyodonts, or those which generate a single set of teeth, and diphyodonts, or those which generate two sets of teeth; the former include the monotremes, edentates, and carnivorous cetaceans, and the latter all the other orders.—For full details on this subject the reader is referred to the following writings of Prof. Richard Owen: "Odontography" (London, 1840-'45); article "Teeth" in vol. iv. of the "Cyclopædia of Anatomy and Physiology" (1852); and "The Principal Forms of the Skeleton and Teeth," in vol. i. of Orr's "Circle of Sciences" (London; reprinted in Philadelphia, 1854).

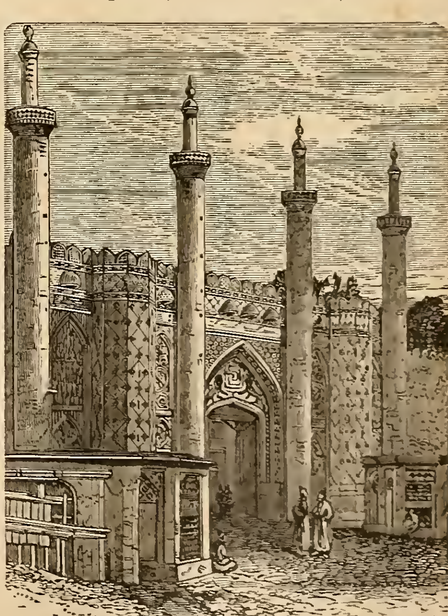
**TEGEA,** an ancient city of Greece, in the S. E. part of Arcadia. Its territory was called Tegeatis. It is mentioned in the Iliad. Its early history was marked by a constant war with the Spartans, and about 560 B. C. it fell into their hands. About 500 Tegeans fought at Thermopylæ, and 3,000 at Platæa. Tegea became a member of the Arcadian confederacy after the battle of Leuctra (371), and subsequently of the Ætolian league. After the Roman conquest of Greece it continued to be a place of considerable importance, but about A. D. 400 was totally destroyed by Alaric. Its remains, found near the village of Peali, about 4 m. from Tripolitza, consist of broken columns, friezes, and architraves, and a church in ruins.

**TEGNÉR, Esaias,** a Swedish poet, born at Kirkerud, Wermland, Nov. 13, 1782, died in Wexiö, Nov. 2, 1846. He was the son of a clergyman who had assumed the name of Tegnér after his native village of Tegnaby. He graduated at the university of Lund in 1802, and became teacher of æsthetics and librarian there, and in 1812 professor of Greek. In 1818 he was elected to the academy of sciences and took his degree in divinity, and in 1824 he became bishop of Wexiö. His works include *Svea* (1811); *Nattvards Barnen* ("The Children of the Lord's Supper," 1820), Longfellow's version of which (1841) was regarded by Tegnér as the best of all the translations; *Axel* (1821); and *Frithiofs Saga* (1825), based upon Icelandic sagas. The last has been repeatedly set to music, and translated into many languages. Among the latest versions are Count Leinburg's in German (Frankfort, 1873), Leopold Hamel's in English (London, 1875), and Victor Wilder's in French, set to music by Max Bruch (Paris, 1875). A complete collection of Tegnér's published works was edited and his biography written by his son-in-law Böttiger (7 vols., Stockholm, 1847-'51; new ed., 1871 *et seq.*); and a collection of his posthumous writings has been made by Elof Tegnér (3 vols., 1874). His correspondence has also been recently published. A colossal statue of Tegnér was erected at Lund in 1853.



**TEHAMA,** a N. county of California, lying between the Sierra Nevada and the Coast range, and intersected by the Sacramento river; area, 2,800 sq. m.; pop. in 1870, 3,587, of whom 294 were Chinese. Lassen's peak, in the N. E. corner, is 10,577 ft. high. The E. portion is partly rocky and barren and partly covered with forests of pine. In the west are several well watered and fertile valleys. Some gold is found in the Sierra Nevada, and salt and medicinal springs of great value in the Coast range. The Oregon division of the Central Pacific railroad traverses it. The chief productions in 1870 were 404,722 bushels of wheat, 108,323 of barley, 445,456 lbs. of wool, 68,185 of butter, 33,000 gallons of wine, and 6,549 tons of hay. There were 3,069 horses, 2,157 milch cows, 9,408 other cattle, 130,868 sheep, and 19,459 swine; 3 flour mills, 6 saw mills, and 2 manufactories of gloves and mittens. Capital, Red Bluff.

**TEHERAN,** or **Tehran,** the capital of the kingdom of Persia, and of the province of Irak-Ajemi, 70 m. S. of the Caspian sea and about 210 m. N. of Ispahan, in lat. 35° 41′ N., lon. 51° 23′



Old South Gate.

E.; pop. in winter about 100,000. The town stands in a sandy plain, with mountains to the north and east, and a fertile, well cultivated country to the west. It is built in the form of an irregular square, each side of which measures about a mile, and is enclosed by a deep

dry ditch and a thick mud wall, flanked at intervals with semicircular projections, and pierced by gates which are always guarded, and are closed after sunset. Inside there are many vacant spaces, gardens, and extensive ruins; but the streets are narrow, irregular, unpaved, and filthy. The houses are badly built and mean in appearance. Outside the walls are suburbs of considerable extent, several large caravansaries, and many enclosed gardens. The principal building of the town is the Ark or royal palace, which occupies a large space adjoining the northern wall, and is fortified. The bazaars are wretchedly kept and dirty. One of the mosques is roofed with plates of gold. In summer the climate is unhealthy, and the monarch and about two thirds of the inhabitants encamp on the plains of Sultanieh. On a hill in the neighborhood the shah has a palace and beautiful gardens. Telegraph wires connect Teheran with the Caucasian and Turkish frontiers. Not far from it are the ruins of the ancient Rhages, the capital of Parthia.—Teheran was unimportant until made the capital of Persia by Aga Mohammed Khan about 1796. A treaty of commerce with England was signed here, Oct. 28, 1841.

**TEHUANTEPEC.** **I.** An isthmus of Mexico, lying between the bay of Campeachy on the gulf and the bay of Tehuantepec on the Pacific, and comprising the states of Tabasco and Chiapas and parts of Vera Cruz and Oajaca. Its breadth from bay to bay, at the narrowest place, is 130 m. It is drained by the Coatzacoalcos river, which flows northward, discharging into the bay of Campeachy, and extending three fourths of the width of the isthmus; and by the Tehuantepec river, flowing into the bay of the same name. There are several lakes and lagoons. At one time it was proposed to construct a ship canal across the isthmus, improving the navigation of the Coatzacoalcos for a part of the distance, and surveys were made. (See Canal, vol. iii., p. 690.) **II.** A town of the state of Oajaca, on Tehuantepec river, about 15 m. above its mouth, and 110 m. E. S. E. of Oajaca; pop. about 14,000. The houses are generally of stone. Part of the town is occupied by Indians, who are civilized and industrious. It has salt works and cotton factories, and a considerable pearl fishery in which many of the inhabitants are engaged. Indigo is raised in the vicinity, a purple dye is procured from a shell fish abundant there, and some cochineal is exported. The harbor is shallow, with a dangerous bar at the mouth of the river, and is little frequented.

**TEJADA,** or **Lerdo de Tejada, Sebastian,** president of Mexico, born in Jalapa, April 25, 1825. He was educated in the seminary of Puebla and in the college of San Ildefonso, in the city of Mexico, became rector of the college in 1852, and received the diploma of advocate in 1853. He was a judge of the supreme court from December, 1855, to June 1, 1857, when he became minister of foreign affairs and premier, but resigned in September on account of his support of the new liberal constitution, in opposition to President Comonfort. He was a member and thrice the president of the house of representatives during the sessions of 1861–'2. He opposed the treaty for arranging the English debt, and its failure led to the downfall of the Zamacona cabinet. His influence led to the ratification in December, 1861, of treaties of commerce and of extradition with the United States. He was member of congress in 1862–'3, and followed the government on its removal from Mexico, during the French invasion. On Sept. 2, 1863, he became minister of justice, and on Sept. 11 of foreign affairs. He shared with Juarez the honor of the eventual recovery of the national independence. The presidential term of Juarez expiring on Nov. 30, 1865, Lerdo de Tejada, to avert the excitement of a new election, caused the presidential term to be extended until the termination of the war. After the capture of Maximilian, he was vainly solicited to spare his life. After the return of Juarez to the capital, in July, 1867, Lerdo de Tejada suspended all treaties with those foreign powers which had failed in neutrality toward Mexico, or had joined in the intervention; but he accorded to aliens the same security as to Mexicans. In 1868 he became chief justice of the supreme court. In that capacity, under the constitution, he became president on the death of Juarez in July, 1872; and on Nov. 1 he was almost unanimously elected to that office for the term ending Nov. 30, 1876.

**TELEGRAPH** (Gr. τῆλε, afar, and γράφειν, to write), an apparatus by which intelligence is communicated to a distance. It properly includes the various methods of signalling. The Roman generals, as described by Julius Africanus, spelled words by means of fires of different substances. The North American aborigines made use of regular stations over the western country for such signals; and the Indians of the northwest territory in this way made known the approach of Fremont, as he passed through their regions. Polybius describes two modes of telegraphing by means of torches; and Bishop Wilkins, after giving an account of this in his book entitled "Mercury, or the Secret and Swift Messenger," describes a method of conversing at a distance with three lights or torches at night, which may be so used as to indicate the 24 necessary letters of the alphabet, these being divided into three classes of eight letters each, which are severally designated by one, two, or three torches, and the number of the letter by the number of times the torches are elevated or displayed. Another method was also proposed by Bishop Wilkins, in which intelligible signals were conveyed by means of two lights attached to long poles; and for long distances he suggested the use of the then newly invented telescope. A variety of systems of telegraphic signals were brought into notice by different inventors in the 17th and 18th centuries, one

of the earliest of which is that of Dr. Robert Hooke described in the "Philosophical Transactions" for 1684. It consisted of 24 symbols formed of blocks of wood, representing alphabetic characters, and six more formed of curved lines to be used as arbitrary signals. These were to be exposed in succession in an elevated frame at some conspicuous point, and, being observed at another station, were to be there repeated and sent forward to the next, and so on. At night torches or other lights were to be substituted for the wooden figures. The first working telegraph of much importance was that known as Chappe's, invented in 1792, which was brought into use during the wars of the French revolution. At the top of a tall post was attached a cross bar upon a pivot, so that it could be easily turned from a horizontal to an inclined position. Each end of this cross bar carried a short arm, which could also be turned upon its pivot so as to stand in any position in relation to the bar. The movements were made by means of ropes which passed through the bar and down the post. This apparatus admitted of 256 distinct signals; but M. Chappe limited its use in great part to 16 signals, each one of which represented a letter of the abbreviated alphabet he had constructed. Chappe's method has been generally adopted, all the alleged improvements in it being of minor importance. Mr. R. Lovell Edgeworth about the same time brought before the public his plan of a telegraph, or as he called it telelograph or tellograph, by which the signals represented numbers, the meaning of which would be found in the dictionary prepared for this system. The signals were made by means of four pieces of wood, each one in the form of a long isosceles triangle, placed near together, each supported upon a pivot round which it could be turned in any direction. The movements of each were limited to eight, and indicated the first seven numerals and zero. The first triangle or pointer represented units, the second tens, the third hundreds, and the fourth thousands, so that any number might be expressed that did not contain the figure 8 or 9. The admiralty telegraph proposed by Lord G. Murray was used in England from 1795 to 1816, when it gave place to that known as the semaphore (Gr. σῆμα, a sign, and φέρειν, to carry), which the French had adopted in 1803. This consisted of six conspicuous boards or shutters set in a frame, each of which could be turned upon its axis so as to present either its edge or its broad surface to the next station. The movements represented figures, and a series of numbers was indicated by their combinations. Some of these stood for the letters of the alphabet, and the others for arbitrary signals. The French semaphore (also known as signal posts) consisted of three or more arms attached by pivots to an upright post, admitting of motion in any direction, and indicating by their various positions either figures or letters. Many modifications of this apparatus were used. For telegraphic communication at sea, flags of various colors have long been used. (See Signals, Naval.) In 1835 Gauss proposed to employ a small heliotrope or mirror for reflecting rays of light from the sun or an artificial source as a means of communicating signals. With a mirror so small that it may be carried in the waistcoat pocket, flashes of light may be clearly perceived for 12 m. or more, and, the mirror being gently moved on some established system, the appearance and disappearance of the flashes may indicate letters or words. By this device time can be saved, telescopes dispensed with, and the signals seen only by those for whom they are intended. Francis Galton, the African traveller, proposed a plan similar to this at a meeting of the royal geographical society, and described an optical arrangement he had devised by which the operator may know if the mirror is directed aright. Among the later publications upon the telegraphs adopted previous to the electric telegraph, are papers in the "Journal of the Society of Arts," vols. xxvi., xxxiv., xxxv., and xxxvi.; "A Treatise explanatory of a new System of Naval, Military, and Political Telegraphic Communications," &c., by John Macdonald (London, 1817); "Description of the Universal Telegraph for Day and Night Signals," by C. W. Pasley (London, 1823); and Edgeworth's "Essay on the Art of conveying Secret and Swift Intelligence," in the "Transactions of the Royal Irish Academy," vol. vi. The advantage of all these methods of telegraphing, which may be described in general as the optical method, is, that they employ nature's great highways, which cost nothing; the disadvantages are, that the signals cannot record themselves, but require the constant attention of an observer, and can be used only for moderate distances and in favorable weather. Moreover, the expense is great compared with the meagre intelligence which is communicated. The semaphore between London and Portsmouth, 72 m., which could be used less than one fifth of the time, required an annual expenditure of £3,403.—Electric Telegraph. The various kinds of electric telegraphs may be classified in two ways. In the first place, they differ in regard to the source from which the electricity is derived. In the present state of science, five independent sources of electricity are recognized: 1, friction; 2, chemical action; 3, magnetic induction; 4, heat; 5, physiological actions. The difficulty of insulation unfits frictional electricity for this work, except at short distances and in dry air. The fourth and fifth sources must be rejected as insufficient for practical use. Successful telegraphs must rely on electricity produced by chemical action or magnetic induction. In the second place, electric telegraphs may be classified according to that one of the five special effects of electricity which is selected as the means of delivering the message when

it arrives: 1. The statical attractions and repulsions would be impracticable except with frictional electricity. 2. The chemical effect of electricity is capable of making a visible sign and also a permanent record. 3. The magnetic effect is able to make a visible sign, as in the needle telegraph; it can also prick out its message in an artificial alphabet, or even print it in ordinary type. 4. The physiological effect can furnish a signal which may be felt. 5. The luminous and the calorific effects can be used for visible signals, but they cannot write or print. Of the manifold attempts at electric telegraphs, the best are now known to be those which employ the chemical or the magnetic effects. As the chemical telegraph works silently, an electro-magnet is required even in this case to attract the attention of the person who is to receive the message. The electro-magnetic telegraph can address the eye or the ear, and can also write or print.—Attempts have been made to prove that the electric telegraph was foreshadowed more than two centuries ago. Prof. Mannoir puts in a claim for Dr. Odier on account of a letter which he wrote in 1773. But Addison, in No. 241 of the "Spectator," written in 1711, quotes from the *Prolusiones Academicæ* of Strada a description of essentially the same arrangement as that proposed by Dr. Odier. Moreover, Schwenter in 1636 had the same idea, but borrowed from a still earlier writer. How chimerical the scheme was in all these cases, and how unworthy of being regarded as an anticipation of the real discovery, will appear from the following brief description of the project: A magnetized needle is free to move over a graduated dial, the marks being the letters of the alphabet. One of these instruments stands in one place, and another in a remote city. If the needle of one is placed upon a particular letter, the needle of the other will move to the same letter by virtue of the magnetic forces. Du Fay, Winckler, Lemonnier, Gray, and Desaguliers made experiments, which showed that the effect of electricity could be transmitted to a distance. The discovery made by Dr. Watson in 1747, that electricity would force its way through considerable lengths of wire, and that earth and water could take the place of wire in completing the circuit, furnishes the first facts of any significance in the history of the electric telegraph. He transmitted shocks across the Thames and the New river, in one instance at Shooter's Hill the circuit being composed of about 2 m. of wire and 2 m. of the earth; and he supported his wires upon posts. Franklin made similar experiments across the Schuylkill river in 1748, and De Luc afterward on the lake of Geneva. Signals were communicated by means of the electric shock from one apartment to another by Lesage at Geneva in 1774, and by Lomond in France in 1787 by the divergence of pith balls on some concerted plan; and in 1794 Reizen of Germany employed the electric spark for telegraphing, making use of interrupted strips of tin foil, so arranged that the form of the letter or figure was exhibited by the sparks. He employed 36 wires from one station to another, each one of them communicating with one of the letters or figures, and each one connecting with a return wire, thus making 72 in all. This plan is described in vol. ix. of Voigt's *Magazin*. Cavallo in his "Treatise on Electricity" (1795) suggests the explosion of gunpowder to call attention, and then the transmission of signals by a succession of sparks at intervals and in numbers according to the system agreed upon. Don Francisco Salvá of Madrid and Sr. Betancourt constructed similar telegraphs at Madrid in 1797 and 1798, one of them extending between Madrid and Aranjuez, about 26 m. (Voigt's *Magazin*, vol. xi.) Salvá communicated his plans to the royal academy of sciences at Barcelona, and according to the journals of 1797 they were highly commended by the minister of state. Salvá appears to have had a clear idea of the practicability of electric communication even beneath the sea, and in the last of his memoirs he proposed to substitute the voltaic pile for the electrical machine. Other attempts to employ frictional electricity were made by Francis Ronalds at Hammersmith, England, in 1816, on a line of 8 m.; and in 1827 by Harrison G. Dyar at the race course on Long Island, N. Y., on a line of 2 m. The latter made use of iron wire, glass insulators, and wooden posts, and employed for signalling the chemical power of the electric current to change the color of litmus paper. Ronalds introduced the plan of employing a clock at each of the two stations, both of them running together exactly, and each bringing into view one after the other the letters of the alphabet arranged upon a disk which revolved behind a screen with an opening for one letter. Each clock was provided with two pith balls connected with an electrical machine at the other station; and their divergence called the attention of the other operator to the letter then in view. The voltaic pile, discovered in 1800, furnished in its continuous current a more promising agent for transmitting intelligence than the sudden and transient discharge of the friction machine. Sömmering began his experiments in 1809, and devised a plan of telegraphing which was as perfect as was practicable at that time. He used 35 wires, terminating in gold points, set up vertically on a horizontal line at the bottom of a glass reservoir of water. In the other direction these wires, brought together in a tube, extended to the other station, where they again diverged, terminating in brass plates attached to a horizontal wooden bar. The plates at one end and the points at the other were marked with corresponding letters, and whenever a momentary current was sent through any two of the plates, hydrogen was evolved at one of the gold points and oxygen at

another, and thus two letters were indicated. Sömmering found that the addition of 2,000 ft. of wire produced little or no sensible additional resistance, and that voltaic action was instantaneously developed at least for the distance of 3,000 ft. In 1810 Prof. Coxe of Pennsylvania suggested a method of telegraphing by means of the chemical effect of electricity. Schweigger described an improvement upon Sömmering's arrangement, by which all the wires could be dispensed with except two. The batteries then known were insufficient for the transmission of currents through great distances, and besides were deficient in sustaining power; therefore no further progress was made in perfecting the electric telegraph until the principles of electro-magnetism had been developed. (See Electro-Magnetism.) In 1819 Oersted discovered the power which the current possesses of deflecting a magnetized needle out of the magnetic meridian. In 1820 Schweigger added the multiplier. This was followed by Arago's discovery in the same year that a steel rod was magnetized when placed across a wire which was carrying a current. Ampère immediately substituted a helix for a straight wire. In 1825 Sturgeon used soft iron in place of steel, and the electro-magnet was born. Between 1828 and 1830 Prof. Henry of Princeton, N. J., made great improvements in the construction of electro-magnets by covering the wire and winding the coil compactly. In 1831 he devised an instrument which is essentially the same as the Morse register. Moreover, Ohm in 1827, and Fechner in 1831, published the results of their theoretical investigations into the laws of the voltaic current, which shed a flood of light on the subject of telegraphing at long distances. If these investigations had but little practical effect, it was because they were not generally known until the same results had been at a later day worked out empirically. Equally important was the invention of the constant battery by Daniell in 1836, and of various other constant batteries which have been contrived since that time. The discovery of magneto-electricity by Faraday in 1831, and the introduction at a much later date of the induction coil, supplied constant sources of intense electricity adapted to the telegraph. Within a year after Oersted's discovery Ampère pointed out its applicability to telegraphic signals. His plan contemplated at least 30 needles and 60 independent wires. In 1828 Ritchie gave an experimental illustration of such a device before the royal institution of London. In 1829 Fechner had a similar project for uniting Leipsic and Dresden by means of 24 sets of underground wires. In 1832 Schilling exhibited to the emperor Nicholas of Russia a needle telegraph in operation on a small scale. He used a needle provided with a multiplier of insulated wire for each letter or number to be indicated. The several wires were brought together beyond the multipliers into one cord, and thence passed to the first station. Eventually he succeeded in reducing the number of needles to one. He also introduced an alarum at the commencement of the passage of the current by causing a solid body to fall, on the same principle as had been already recommended by Prof. Henry in his lectures. These experiments were interrupted by his death, and the steps made were lost, without even a very accurate account of the results being preserved. The next experiments of importance were those of Gauss and Weber of Göttingen in 1833 and 1834. They employed first voltaic electricity excited by numerous small elements, and afterward a magneto-electric machine to transmit signals from 9,000 to 15,000 ft. They caused a magnetic bar to be deflected to one side or the other, and interpreted its repeated movements into the letters of the alphabet. The vibrations of the magnet were checked by a damper, or by the use of currents alternating in direction. This telegraph was of practical value in comparing clocks and for other purposes. Gauss stimulated his pupil Steinheil to a bolder undertaking, in which he was assisted by the Bavarian government. Steinheil's telegraph, completed in 1837, extended 12 m., employed but a single wire, and made use of the earth to complete the circuit. The signals were sounds produced upon a series of bells of different tones, which soon became intelligible to a cultivated ear; and the same deflections of the needle that caused the sounds were also made to trace with ink lines and dots upon a ribbon of paper moved at a uniform rate, the alphabet having a remote resemblance to that invented by Swaim in 1829. Steinheil used a magneto-electric machine, but with the magnets stationary and the multiplying coils revolving close to them.—Morse's telegraph, which is generally recognized in all parts of the world as the most efficient and simple, was first publicly exhibited in the university of New York in 1837. It had been gradually brought to a working condition by experiments and contrivances devised by the inventor since 1832, with the assistance of L. D. Gale and George and Alfred Vail. In October, 1837, Prof. Morse filed a caveat in the patent office to secure his invention; and he obtained the patent in 1840, covering the improvements he had in the mean time made in the apparatus. The telegraph was first brought into practical use, May 27, 1844, between Washington and Baltimore. An insulated wire buried in a lead pipe underground was first tried, and failing was replaced with one on posts. The power was derived from a voltaic battery, and an electro-magnet was employed at the receiving station for developing its effects. When the current flowed, this magnet attracted an armature, by which, according to the duration of the current, dots or lines were marked upon a moving slip of paper with a pen or pencil. The apparatus furnished a simple and effective means of recording signals, which by the needle tele-

graph were only evanescent. The apparatus was improved by the substitution of a sharp point for the pen or pencil, which is attached to one end of a lever, at the other end of which is the movable armature. The following illustrations exhibit the several parts of the Morse instrument as now in use. The key, fig. 1, consists of a brass lever L, swung on pivots, and having on one end a button. When this button is pressed down, two platinum wires, *a* and *b*, are brought into contact, thus closing the circuit; when the pressure is removed, a spring lifts the lever, separates the wires, and breaks the circuit. When the message is sent the operator permanently closes

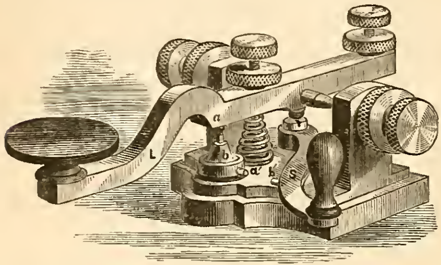



Fig. 1.—Key.

the circuit by springing to the left the lever S, which brings into contact the duplicate platinum wires *a′ b′*. The relay magnet, fig. 2, is an electro-magnet wound with a long fine wire, which is introduced into the main line and becomes a part of the great conductor from city to city. When the key breaks and closes the circuit, the relay receives the voltaic

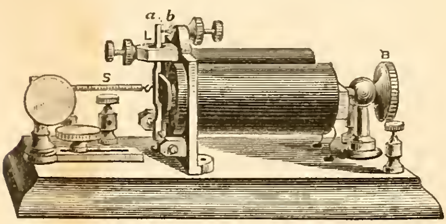



Fig. 2.—Relay.

current and becomes magnetized and demagnetized. The delicately poised lever L, having the armature of the magnet attached to it, vibrates forward and backward, bringing together the two platinum wires *a b*, and thus breaking and closing a secondary or local circuit, embracing a local battery and a strong electro-magnet. This magnet performs various work, such as embossing or printing paper, or the liberation of machinery for the production of sounds. A screw B is used to move the magnet coils backward and forward so as to adjust the general magnetic power, and a spring S retracts the armature after magnetic attraction has drawn it forward. The sounder, fig. 3, is an electro-magnet used in the local circuit. The armature, A, is attracted by the electro-magnet M, causing the lever L to vibrate between the screws S S, which are so adjusted as to limit the vibrations. The backward and

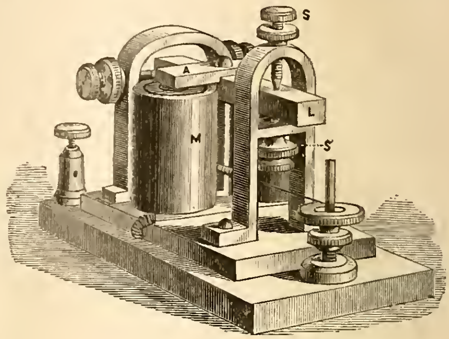



Fig. 3.—Sounder.

forward blows thus given, some of which are short and some long, correspond to the dots and dashes of the Morse alphabet. This is now more generally used than the Morse register or recording instrument, as experience has proved that fewer errors are made by the ear than by the eye. The Morse register, fig. 4, has also the electro-magnet M, the armature A, the lever L, and the adjusting screws S S; but instead of producing sounds merely, the lever L embosses on a fillet of paper P dots and dashes in precise accordance with the movements of the key and relay. The paper is carried between two rollers, moved by clockwork, in one of which is a groove, into which the steel point presses the paper. When successive blows are struck on the key, closing and opening the circuit quickly, corresponding dots appear on the paper; but if the key be pressed down for a longer or shorter time, keeping the circuit closed, a continuous line of any desired length may be produced on the paper. The signs for the letters of the English alphabet

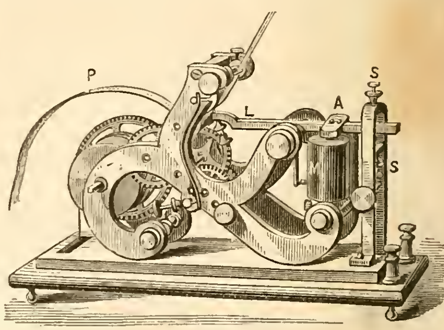



Fig. 4.—Register.

(which are variously modified to adapt them to other alphabets), and for the numerals and punctuation marks, are as follows, those most used being the simplest:

LETTERS.

| | | | | |
|---|---|---|---|---|
| A - — | G — — - | M — — | S - - - | Y - -  - - |
| B — - - - | H - - - - | N — - | T — | Z - - -  - |
| C - -  - | I - - | O -  - | U - - — | & -  - - - |
| D — - - | J — - — - | P - - - - - | V - - - — | |
| E - | K — - — | Q - - — - | W - — — | |
| F - — - | L —— | R -  - - | X - — - - | |

NUMERALS.

| | | | | |
|---|---|---|---|---|
| 1 - — — - | 3 - - - — - | 5 — — — | 7 — — - - | 9 — - - — |
| 2 - - — - - | 4 - - - - — | 6 - - - - - - | 8 — - - - - | 0 —— |

PUNCTUATION.

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| Period | - - — — - - | Exclamation | — — — - |
| Comma | - — - — | Quotation | - — - — - — - — |
| Interrogation | — - - — - - | Parenthesis | — - - - - — |

The slightness of the difference, which cannot be avoided, between some of the signs, as in the C and S, I and O, L and T, &c., exposes to mistakes, which in case of writing in cipher cannot be corrected, and not always when the message is perfectly understood by the operator who sends it. Thus a merchant telegraphed from New Orleans to his correspondent in New York to protect a certain bill of exchange; the word "protect" was read as "protest," and involved serious consequences.—What is known as the English telegraph is the result of the investigations and inventions of William F. Cooke, whose attention was directed to this subject in March, 1836, when a student at Heidelberg, by witnessing an experiment performed by Prof. Möncke of causing the deflection of a magnetic needle by the electric current. In July of that year Cooke produced an experimental instrument, which he not long afterward took to England and sought to introduce on the Liverpool and Manchester railway. He there became associated with Prof. Wheatstone, and the two united their labors to perfect the instrument. The first patent for an electric telegraph was issued to them on June 12, 1837. They employed five magnetic needles and coils, and either five or six wires, with a peculiar keyboard invented by Wheatstone, upon which were arranged the letters, and these were designated in turn as any two of the needles arranged across the centre of the board pointed to one and another of them. The apparatus underwent various modifications in the hands of its inventors, and was much simplified by the use of only two needles, and finally of only one, different letters being designated by the deflection of the needle to the right or to the left one or more times in either or both directions. The swinging of the needle is checked by small pins fixed on the dial, so that the motions are rendered precise and clear. In this single-needle telegraph, each instrument has its own battery and wire. In case of accident to the wire of one instrument, that of the other serves to keep up the communication. With each apparatus was formerly connected an alarum bell, the clapper of which was moved by a weight or spring connected with clockwork, which was released by means of an electro-magnet. This is now generally abandoned, the sound made by the click of the needle against the pins being found sufficient. Wheatstone introduced one very important feature in his electric telegraph, which is a local battery for working the alarum. It is brought into action by the deflection of a magnetic needle, the ends of which are thus placed in contact with the two wires of the second battery, and so close its circuit. The double-needle telegraph is often used upon the railways of Great Britain, each needle having its own wire. The different signs are made by the movements of one or both of the needles. The needles upon the dial are moved by the messages sent as well as by those received, so that each operator may see the signals he makes. In these needle telegraphs no record is made of the message by the instrument itself; the operator observes the signs, and notes them upon paper as they succeed each other. With the English double-needle telegraph, employing two wires and two batteries and other apparatus at each station, an expert operator can send as many as 150 letters a minute; but this is more than can be correctly read, the limit of which is about 100 letters a minute, and in actual practice the number is somewhat less than this, or from 17 to 24 words a minute. Operators accustomed to the work do not require the lettered dial for reading the movements of the needle.—Of the numerous telegraphic inventions that soon succeeded those already named, Alexander Bain's are particularly worthy of notice. He was engaged in England as early as 1840 in producing a printing telegraph, and in 1846 patented what is known as an electro-chemical and registering telegraph, the principle of which had been first applied to the purpose by Dyar in this country in 1827, and by Edward Davy in England in 1838. Mr. Bain brought his new telegraph to the United States in 1849, and it was brought into use on several important lines; but after a lawsuit involving chiefly the use of the local circuit, the Morse interests forced a consolidation, and the Bain system had afterward but a limited use. The local circuit gave to the Morse system its great importance and value. On long lines of telegraph the wire offers such resistance to the passage of the current that its presence is detected only by delicate instruments, which however are capable of vibrating levers whose office is to open and close secondary or local circuits; and these circuits being short, unlimited magnetic power may be obtained for recording or producing sounds. The Bain telegraph was essentially the same as that now called the "automatic." The revival of the system is due to recent discoveries in the arrangement of circuits, by which the rapidity of recorded electrical impulses through very long conductors has been made almost infinite. For recording, dots and lines are produced on chemically prepared paper, which is moved while damp at a uniform rate over a metallic roller; a fine wire, through which the line current passes, rests on the surface of the

paper and blackens it by decomposing the chemical. The current was formerly sent over the line by the key, as in the Morse system; but to call attention a bell was used, and this usually required the local circuit. Mr. Bain had at this time fully developed a plan for transmitting signals with a rapidity far greater than could be effected with the key, and this plan is the same as that now used in the revived system. In place of the key a fillet of paper was punched with lines and dots representing a message. This was passed over a metallic roller with great speed, and a fine wire which rested on the paper entered each hole as it moved and completed the circuit through the roller. The receiving machine was made to run at a speed corresponding with that of the transmitting machine, and the perforated dots and dashes were reproduced in blackened dots and dashes. The advantage of this system lies in the transmission of long messages, which are received and prepared by several operators, at great speed. Until recently this speed could be obtained only on short circuits, the marks on long circuits running into each other and becoming illegible. Later improvements have enabled messages to be sent from Brussels to Ostend and back at the rate of 450 words a minute; and the American instruments have sent between Washington and New York 5,250 letters a minute, requiring 10 perforators to feed it, 10 copyists, and two operators.—*Facsimile Telegraphs.* Electric copying or facsimile telegraphs are modifications of the automatic chemical. They originated with F. C. Bakewell of England in 1850, and have been improved by Caselli, Bonelli, and others. In them the message is written with a pen dipped in varnish upon a sheet of tin foil, which is then laid around a metallic cylinder, corresponding precisely in its size, rate of revolution, and longitudinal movement, with another cylinder at the receiving station, which is covered with chemically prepared paper and provided with a pointer like that of the Bain chemical telegraph. These cylinders being set in motion at the same instant, the point of the registering apparatus makes a continuous colored line, running round the cylinder in a close spiral so long as the metal style at the other station presses upon the tin foil; but as this passes over the lines of varnish a break in the circuit occurs, causing an interruption of the colored line at the other station. The blank spaces thus produced will be found when the lines have been drawn over the whole paper to be a facsimile of those written in varnish upon the tin foil. The lines, though drawn as spirals upon the cylinder, appear as parallels when the paper is taken off. About 10 revolutions of the cylinder, making as many parallel lines, are sufficient to complete one line of writing; a cylinder 6 in. in diameter affords sufficient length for about 100 letters of the alphabet in one line; and as the rate of revolution is not less than 30 in a minute, 300 letters or more may be transmitted in this period. A message in cipher can be sent by this method without risk of error, and even invisible messages written in colorless varnish may be received and impressed in invisible characters upon prepared paper, to be afterward brought out by chemical means; thus, if the paper be moistened with diluted acid alone, no visible mark is left upon it until it is brushed over with a solution of prussiate of potash, when the lines appear in their blue color. Great improvements in the autographic telegraph have been made by Caselli, who has succeeded in making dark letters upon a white ground. His instruments have been used on some of the French lines since 1862.—*Printing Telegraphs.* Royal E. House, of Vermont, received a patent in 1848 for an admirable long-line printing apparatus, which was first used in 1847, sending messages in Roman capitals between Cincinnati and Jeffersonville, Ind., 150 m. The necessity of avoiding the peculiar features upon which other telegraphic systems were established, in order to give to it a distinctive and patentable character, added greatly to the difficulties of the undertaking, which after nearly six years of labor were overcome by the ingenuity and perseverance of Mr. House. The apparatus is very complicated, and little more can be attempted than to state its great powers of execution and its perfect accuracy. The mechanical movements of this machine are set in action by hand labor applied to a crank, which works an air pump for supplying a current of condensed air, which under the control of the electric current carries forward the movements of the composing and printing apparatus, so that each letter may be printed at the exact instant that it is struck upon the keyboard of the instrument. This keyboard, which resembles that of a piano, is connected with the electric current, and as the keys are struck the circuit is opened and closed with the movements of a circuit wheel which controls the movements of the type wheel. A complete revolution of the circuit wheel, coming round again to the same letter, breaks and closes the circuit 28 times, and other letters a less number according to their arrangement on the type wheel. The printing apparatus is quite distinct from the circuit, but the composing apparatus forms a part of it. The impression of the letter is produced by a blackened ribbon being pressed against the paper by the type. From the voltaic battery of one station, the current passes along the wire to the next station, then through the coil of an axial magnet to the insulated iron frame of the composing machine, and thence to a circuit wheel revolving in this frame. Through a spring that rubs on the edge of this wheel it passes into the return wire, and through another battery back to the first station to pursue the same course through the composing machine and magnet there, and all others upon the line. In sending a message, the operator sets his machine in motion and

gives a signal by breaks of the circuit, repeated a different number of times for different offices on the same wire. As this is heard by the operator at the receiving station, he sets his machine in motion, and the type wheel at its starting point, and signals back that he is ready. No further attention is required on his part, while the machine goes on, printing the communication in Roman capitals upon the long strip of paper regularly supplied to the type wheel. From 250 to 260 letters as a maximum can be accurately printed every minute, and over 3,000 words an hour of press news, partly abbreviated, have been sent over the wires with a single instrument. The House printer was the parent of many others working on the same principle, the "step by step" movement, in which each break or close of circuit allows a tooth of an escape wheel to pass; a type wheel being on the same shaft, a new letter appears for each tooth that escapes.—On May 20, 1856, Mr. Hughes patented a telegraph, in which the feat of printing a letter with every impulse or wave of the electric current was accomplished. In the other telegraphs, as already described, several impulses produced by successive makes or breaks of the circuit are required to form a single letter; this in House's telegraph varies up to 14 breaks, the maximum required for repeating the same letter, and averages about 7 impulses; and in the Morse system the average is about 3½ impulses, those which make lines being of longer duration than those which make dots. The saving of time thus effected by the Hughes instrument is of great importance, especially on long lines in which an appreciable amount of time is expended in the passage of the current. In long lines of submarine telegraphs, as will be noticed below, a greatly increased resistance is experienced in charging the wires with the electric current, and the impulses necessarily succeed each other with extreme slowness and diminution of force. The type wheel in the Hughes system is provided with 28 types; it is kept in rapid revolution during the whole time of operating, and is so perfect in its movement that, though the revolutions may be from 100 to 140 a minute, the variations of two machines at different stations do not exceed $\frac{1}{20}$ of a second in several hours. At the instant one of the 28 keys is depressed, the current entering the magnet at the distant station causes the strip of paper to be brought against the type opposite to it at the time, and receive the impression in ink while this is rapidly carried round with the wheel. The operator can send an average of two impulses with each revolution of the type wheel, thus making the capacity of the instrument 200 letters or 40 words a minute, and the maximum is much above this. The regulators or governors of the clockwork which carries the type wheels at the different stations are springs of the same musical tone, which consequently vibrate the same number of times a second, and which control by their vibrations the escapement of the apparatus. The power of the electric current required is reduced in a wonderful degree by the combination of the natural magnet and the electro-magnet, making only so much electricity necessary as will neutralize the magnetism in the natural magnet by causing magnetism of an opposite polarity to be created in the poles of the electro-magnet. This extreme delicacy, however, renders the telegraph liable to be interrupted by atmospheric electricity, such as is developed previous to and during the continuance of the aurora borealis. It is asserted that this instrument can work upon a longer line without the aid of repeaters than any other, and this with an extraordinarily low battery power.—In the winter of 1858 a new instrument was perfected by G. M. Phelps of Troy, combining the most valuable portions of both the House and Hughes patents, which has been introduced with great success on nearly all the lines formerly using those inventions. This has been termed the "combination" instrument, and has the advantage of being able to work through a much longer circuit than the House machine, with a smaller battery, as well as of being much simpler. The keyboard and transmitting machinery of this instrument are precisely like those of Hughes, as is also the printing apparatus, with the exception of the electro-magnet, which is of the ordinary form, and operates upon the type wheel through the medium of compressed air as in the House machine. The vibrating spring used by Hughes as a governor is superseded in the combination instrument by a most ingenious electro-magnetic governor, the invention of Mr. Phelps. It consists of a hollow iron drum, geared to the transmitting cylinder and type wheel of the instrument and moving with them, but much faster. If the machinery has a tendency to revolve too rapidly, the increased centrifugal force, acting upon a detached section of the drum, actuates a series of levers inside, by which a spring is raised, closing the circuit of a local battery through an electro-magnet. A friction brake, which is applied to the revolving drum by the attraction of this magnet, instantly reduces the speed to the required limits, when the local circuit is again broken. The combination instrument is considered the most perfect printing telegraph for long lines yet produced. The Anders printing telegraph, patented in 1871, and worked by magneto-electricity, is designed for private lines, though capable of operating over distances of 45 m. —*Dial Telegraphs.* In these instruments the step by step movement is generally employed, but the escape wheel does not carry a type wheel, nor do the printing accessories enter into their construction. A light needle is carried around with the escape wheel and points at the successive letters. They are thus visual and not recording telegraphs. In England, the "Magnetic Telegraph Company" employed

magneto-electricity, thus dispensing with voltaic batteries, the use of which involves much care and expense. The apparatus is remarkably compact, without clockwork or complicated movements such as are common in other telegraphs. Though used double, with two sets of magnets, with a wire from each connecting with two needles upon the dial at the opposite station, the whole apparatus, including the tablet or dial, occupies but a few inches of space, and is always ready for instant use, however long it may have remained inactive. The magnets, of horse-shoe form, about 12 in number for each set, are 15 in. long and 1½ in. broad. They are laid one upon another in two piles near together, and fastened down to the table by screws. Opposite the ends of each pile, placed upon a rotating axis, is the soft iron armature, consisting of two cylinders wound around with long coils of fine copper wire covered with cotton. The wire of the two coils is connected together, and one end of each passes in a spiral through the axle to the platform upon which the apparatus rests. One end is thence carried into the earth, and the other goes to the electro-magnet of its own dial, thence to the distant station, and through the instrument there into the earth. The same arrangement is repeated with the other set. The axis of each armature extends toward the operator, and is provided with a crank handle by which each is turned to generate the electric current. The effect is seen in the movement of the two needles placed upon the dial over the magnets. It is asserted that this telegraph is worked with the greatest economy, that it cannot be disturbed by electric storms in the atmosphere, and that its average celerity has been found to be 27½ words a minute, with a maximum of 37⅙. In the United States the dial telegraph is largely used where operators are supposed to have but moderate skill, as in police and private telegraphy. The instruments are worked with a small battery. Primary signals are given by bells, and the letters are pointed out by the revolving needle. The transmitting part is the usual circuit wheel, which breaks and closes the circuit and produces the rotating movement of the needle of the distant instrument. This circuit wheel is arrested, in the process of telegraphing, by a series of pins, one of which is placed opposite each letter. When the A pin of the transmitter is pressed down, the circuit wheel is arrested just as it has caused the needle of the other instrument to rotate to A.—*Construction of Telegraph Lines.* Telegraph wires are usually carried over the surface of the country upon poles standing from 25 to 30 ft. above the ground, and placed from 80 to 100 yards apart. As poles are objectionable in cities, many plans have been devised for carrying the wires under ground. In London they are covered with gutta percha and tape and put into lead or iron pipes, which are laid under the sidewalk, or into creosoted wooden troughs filled with bitumen, which are buried in trenches beside the roadway. In Paris the wires are carried in lead pipes through the sewers and catacombs. The "American Compound Wire Company" have introduced a wire, consisting of a core of steel and envelope of copper, with a tinned surface, which, with equal conductivity and greater strength, weighs less and requires fewer supports. Another insulated wire, called "kerite wire," the invention of Mr. A. G. Day of New York, has a covering compounded of rubber and hydrocarbons. It is said to offer great resistance to oxidation, and that it may be exposed in the air or buried in the earth for years without serious injury. As, with batteries of the same intensity, the conductivity increases with the cross section of the wire, large wires are to be preferred to small ones upon long circuits. In working direct, a distance of over 400 or 500 m., the line is usually divided at some intermediate point into two distinct circuits, which are connected by means of a "repeater." If the circuit be broken on either side of the repeater, it will break the circuit on the other side also. The combined circuits can thus be operated from either end as if they were one continuous wire, while the current of each battery has to pass only half the distance between the terminal stations. A line can thus be extended indefinitely. Copper wire is a much better conductor than one of iron of the same size, and will carry the current from five to six times as far; but want of strength, and frequent breakage from its greater expansion and contraction by the changes of temperature, prevent its use except on important submarine lines. The insulation of the wires upon the posts is a matter of much importance, and is not easily effected, for any non-conductor interposed between the wire and the post becomes a conductor when its surface is wet with rain. Glass knobs with grooves around them for securing the wire have been made in a great variety of forms, and secured to the posts, or to the cross bars where there are several wires, by pins of wood or iron. A great improvement upon this is a glass cap exactly fitting over a wooden pin 1¼ in. in diameter, and having an outer covering of wood, saturated like the pin with coal tar and pitch, to which the wire is fastened, and which, projecting below and entirely covering the glass, keeps it dry and makes the insulation complete. Batchelder's vulcanite insulators have been very extensively applied in the United States. In Europe, insulators of earthenware and porcelain are used. In forests the wires should be allowed to pass loosely through the supports, so that in case of a tree falling upon them they need not be broken; but in an open country they are usually fastened to each post. On some telegraph lines in Europe and in Asia, the wires, instead of being supported upon poles, are buried beneath the ground. Their first cost is always heavy,

and many of them have soon proved failures through imperfection in the insulation. The wires are best insulated by coating them with gutta percha, and they are protected from injury by laying them in pipes of lead or of earthenware, or in wooden boxes preserved by saturating the wood with a solution of sulphate of copper or chloride of zinc. Some of these lines have worked perfectly for many years, but when they fail it is a matter of great expense and difficulty to discover their defective points.—In the extent of its telegraphic lines the United States has exceeded every other country. In 1860 it was estimated that there were over 50,000 m. in operation, and at present there is not less than 150,000 m. of wire. In the aggregate, 700,000 m. of wire spread their network over the earth for telegraphic purposes, including lines in Australia, India, China, and Siberia. Russia is engaged in extending an important line from Moscow to the Pacific so as to connect eastern Asia with Europe, and possibly hereafter with America by the way of Behring strait. This line was completed to Perm, on the borders of Siberia, and from that place across the Ural mountains to Omsk on the Irtish, in 1861. Thence it is continued to Tomsk, and S. E. to Irkutsk; next it passes the Altai mountains to Kiakhta on the Chinese frontier, thence to Cheta on the Amoor, and thence to Nertchinsk. From Orum, or some other point on the Amoor, one branch will go down the river and another southward to a Russian port on the Japan sea. The project of extending these lines to Behring's strait, and across to Alaska, Oregon, and California, which had been partially carried into effect on the American side, was abandoned after the Atlantic cables had been brought into working condition.—*Submarine Telegraphs.* The idea of a submarine telegraph appears to have been conceived by several of the earlier electricians. Salvá is said to have proposed one as early as 1797 between Barcelona and Palma in the island of Majorca. Experiments were made in India by Dr. O'Shaughnessy in 1839 with this object, and he insulated his wires by covering them with tarred yarn, enclosing them in split rattan, and covering this again with tarred yarn. Wheatstone in 1840 gave it as his opinion before a committee of the house of commons that a submarine communication between England and France was practicable. Morse, on Oct. 18, 1842, laid a copper wire, insulated by means of a hempen strand coated with tar, pitch, and India rubber, from Governor's island to the Battery in New York, and the next morning was beginning to receive communications through it, when the wire was caught in the anchor of a vessel getting under way, and being hauled on board was stolen by the sailors. Samuel Colt laid a submarine cable in 1843 from Coney island and Fire island, at the mouth of New York harbor, up to the city, and operated it successfully. The first submarine telegraph wire laid in Europe was across the Rhine from Deutz to Cologne, about half a mile; it was insulated with gutta percha, and laid by Lieut. Siemens of the royal Prussian artillery. This appears to have been the first application of gutta percha to this purpose, the substance about that time first beginning to attract attention. In 1850 a copper wire covered with gutta percha was laid between Dover and Calais by Brett, but its success was short-lived. The next year it was replaced by a cable of four wires, which has given complete satisfaction. In 1853 six cables (the longest of which, between England and Scotland, was about 100 m.) were successfully laid. In 1854 five other cables went into operation, the longest being only about 64 m. In 1855–'6 two more were added, that from Varna to Constantinople being about 160 m. Besides these, two cables had been laid in deeper waters: one from Newfoundland to Cape Breton, and another from Spezia to Corsica. The grand attempts to connect the European and American continents by a cable across the Atlantic, commenced in 1857 and perfected Aug. 5, 1858, have been noticed in the article FIELD, CYRUS WEST. Before these were undertaken great encouragement was given to the enterprise by the successful experiments made on Oct. 9, 1856, in transmitting distinct signals at the rate of 210, 241, and even 270 a minute through a number of connected coils of wires, insulated with gutta percha, and making a total length of about 2,000 m., increased to a virtual circuit of 2,300 m. by the interposition of fine wires at the joinings of the coils. The wires were excited by the magneto-electric coils of Whitehouse, and the signals were received upon the ordinary recording apparatus of Morse. But a great difference was afterward experienced in the working of the wires when submerged. Before the cable was laid it was ascertained that insulated wires acquire a new character when submerged, and that instead of transmitting the current as simple conductors, they are of the nature of the Leyden jar, the gutta percha corresponding to the glass, the inner wire to the interior coating, and the iron covering or the water itself to the exterior coating; and that consequently the cable must be charged throughout the entire length before any current is produced. Among other interesting phenomena, it was observed that the voltaic current is not transmitted so rapidly through such a conductor as the magneto-electric current; and that alternating positive and negative signals are transmitted more rapidly than successive signals of the same character. After being laid, the wires were first worked by the Ruhmkorff induction coils and a Smee battery, and afterward by a Daniell battery; but the current was for the most part so weak as scarcely to operate the most delicate relay, though susceptible to a current that can hardly be perceived on the tongue. The effect was indicated

at the Newfoundland station by the deflection of a delicate galvanometer, and at Valentia in Ireland by that of the reflecting galvanometer of Thomson, in which a delicate magnet carries a small mirror from which a beam of light is reflected. This ray being thrown upon a surface at some distance, a movement of the magnet that is not directly perceptible may be even measured upon a graduated scale. The transmitted current was, much of the time that the cable continued in action, so weak that every expedient of this kind was necessary to render the signals perceptible. From the first there was a defect in the part of the cable laid toward the Irish shore, which caused a temporary interruption of communications between the ships. Between Aug. 13 and Sept. 1 there were 129 messages of 1,474 words sent from Valentia to Newfoundland, and 271 of 2,885 words in the other direction. The message from Queen Victoria to the president of the United States, 99 words, occupied in its transmission 67 minutes. The rate of reception was very variable, the signals being often unintelligible and requiring several repetitions. Electricians were sent to Valentia, and the most powerful batteries, as well as the great magneto-electric machine of W. T. Henley, were applied to test the condition of the cable. The power thus employed was more than 1,000 times what would be required in an ordinarily well insulated conductor to give perfect signals to the mirror galvanometer. To the end of the cable a voltaic battery was connected by one of its poles, a galvanometer was placed in the circuit, the other pole was connected with the earth, and by these means the location of the defect in the cable was ascertained; but all attempts to recover it were unsuccessful. The cost of the cable was as follows: for 2,500 m. at $485 per mile, $1,212,500; for 10 m. at $1,250 per mile, $12,500; and for 25 m. shore ends at the same price, $31,250; making altogether $1,256,250. The expenditures of the company up to Dec. 1, 1858, had amounted to $1,834,500.—After the failure of this great enterprise attention was directed to the practicability of extending a cable across the Atlantic from Labrador to Scotland, by way of Greenland, Iceland, and the Faroe islands. The route is about 1,800 m. long, and presents no continuous length of submarine cable for a greater distance than that between Labrador and Greenland, which is about 600 m. Mr. T. P. Shaffner, of the United States, had obtained in 1854 from the king of Denmark a concession of exclusive rights in Greenland, Iceland, and the Faroe islands for this purpose. He sailed from Boston, Aug. 29, 1859, and made the preliminary surveys at his own expense, and he induced the British government to send a steam vessel to take the deep-sea soundings; but the project was not consummated. The failure of other deep-sea cables, as that between Sardinia, Malta, and Corfu, and the long cable from the Red sea to India, increased the distrust occasioned by the failure of the Atlantic cable of 1858. The result was that a committee, consisting of the most eminent electrical engineers, was appointed by the English chamber of commerce and the "Transatlantic Telegraph Company," to whom the duty was assigned of inquiring into the causes of these disastrous failures, and providing instructions for the future in regard to the manufacture, tests, and placing of cables. It appeared that the mechanical department of the subject was in a more advanced state than the electrical. The committee, after 18 months of hard work, published an elaborate report in 1863. Moreover, the theoretical researches of Thomson, Jenkins, and others, had thrown much light on the electrical requirements of submarine lines. Meanwhile, a cable was laid successfully between Malta and Alexandria in 1861, and the Persian gulf cable (about 1,330 m. long) in 1864. When Mr. Field visited England in 1862, to urge on a second attempt to establish telegraphic communications across the Atlantic, he found that the manufacturers, Messrs. Glass, Elliott, and co., were confident of their ability to make and place a good and durable cable between Great Britain and America, and were willing to incur a part of the risk. The second Atlantic cable, made by the "Telegraph Construction and Maintenance Company," was tested with every precaution, and found to be unexceptionable in its electrical conditions, and was shipped on board the Great Eastern in 1865. This cable (2,186 m. long) consists of seven copper wires (No. 18) twisted into a spiral, covered with four coats of gutta percha, between which are thin layers of Chatterton's compound. The external protection is made of ten iron wires, each surrounded by manila yarn. After about half of the cable had been paid out it broke, and the expedition was abandoned for the season. The total expenditure of money had been about $3,000,000. In 1866 a third cable, of similar construction to the second, but stronger, lighter, and more flexible, was placed on board the Great Eastern and successfully laid. The length between Trinity bay and Valentia is 2,134 m. Its first duty was to transmit a message of peace, viz., that a treaty had been signed by Prussia and Austria. Capt. Anderson returned with the Great Eastern to the place where the cable of 1865 had parted, and succeeded in splicing it and completing the line. In 1869 the French Atlantic line went into operation between Brest and St. Pierre, and between St. Pierre and Duxbury, Mass., the total length being 3,857 m. In 1870 more than 15,000 m. of cable were laid, including the Indian cables (from Suez to Aden, from Aden to Bombay, and from Penang to Singapore), the China cable, and the North China from Hong Kong to Shanghai and from Shanghai to Posiet in the Littoral province of Siberia. In 1874 the work was begun by the "Direct Cable Company" of laying the new Atlantic line between Ballinskilligs bay,

in Ireland, and Rye, New Hampshire, by the way of Nova Scotia. In spite of many obstacles and delays, the cable was put in position between Rye Beach and Torbay, N. S., and between Torbay and Newfoundland, also between Cahirciveen island and a point 200 m. E. of Newfoundland, before rough weather put an end to the work. The final splice of 200 m. was made early in the summer of 1875. In 1873 a cable was laid between Lisbon and Madeira; in 1874 Madeira was connected by cable with St. Vincent, one of the Cape Verd islands (1,200 m.), and St. Vincent with Pernambuco (1,845 m). In 1875 cables were laid between Jamaica and Porto Rico, Constantinople and Odessa, Zante and Otranto, and Barcelona and Marseilles. In all, more than 200 cables have been laid, with a length of about 50,000 m.—The interval of time which must elapse between the sending of successive signals through similar cables increases as the square of their lengths; and in different cables of equal length, this time is the least when the thickness of the insulating coating is one third of the diameter of the compound conductor. With the improved transmitting apparatus of Thomson and Varley, eight words can be sent in the time otherwise required for one. Seventeen words a minute have been sent through the French Atlantic cable. Thomson's syphon recorder quadrupled the speed of cable telegraphy. The current from the cable passes into a coil of wire suspended between the poles of magnets. The coil turns round in a direction depending upon the direction of the current. The motion of the coil is communicated by means of a thread and lever to a glass syphon which feeds itself with ink from a basin. The ink is electrified and spurts out against a moving strip of paper, and draws an undulating curve which indicates the letters of the message. The speed of working with this recorder is about the same as with the reflecting galvanometer; and in either case it is much greater than could be attained by the moving armature, which requires that the current should rise and fall by large differences; and this would take more time.—*Telegraphic Disturbance.* The offices and operators of air lines of telegraph are exposed to accidents from lightning, either from the direct stroke or the induced electricity when a discharge occurs between two clouds. A great many lightning guards have been devised. Sabine mentions eleven. In lines which follow the undulations of mountainous regions (as between Vienna and Milan), there is so great disturbance from atmospheric currents, even under a blue sky, that it is impossible to send messages at certain hours. The aurora sometimes acts powerfully upon the wires, interfering with the battery currents. On such occasions, if the battery be taken off, the messages may be sent by means of the current induced by the aurora. The action of cable lines is disturbed by earth currents. Generally, the difference of electric potential between different parts of the earth is small; but it is subject to sudden and capricious changes, and amounts sometimes to that of a battery of 140 of the Daniell elements. The direction of these earth currents is such as to derange particularly the Atlantic lines. The instruments are protected by the use of the condensers of Varley and others. These earth currents must not be confounded with those excited when plates of zinc and copper are buried in the earth, which Kemp, Fox, and Reich made the subject of numerous experiments, and which Bain, Palagi, and others put into the harness to work the telegraph.—*Various Uses of the Telegraph.* The electric telegraph has been applied to uses never contemplated by its originators. In 1852 Channing and Farmer of Boston devised a system of telegraphic fire alarms, which was adopted in the city of Boston. Five so-called signal circuits were extended from the city hall to different parts of the city, and in connection with these were stationed 50 signal boxes attached to buildings at convenient points. The door of a box being opened, a crank is seen with directions for the number of times it is to be turned to convey to the central office the number of the station and district. From the central station five wires called alarm circuits connect with the different fire bells throughout the city, the hammers of which, run by weights, are set in action by the telegraph itself and strike the number of the district and station of the alarm. The electric current is excited by a magneto-electric machine which is set in motion by the pressure of the water with which the city is supplied, and the same power is employed to wind up the weights that move the bell hammers. The bells have been rung, as an experiment, from Portland through the telegraph wires extending to that place. The fire alarm also affords an incidental protection to the city from lightning. Large metallic surfaces being placed near the wires at all the stations and connected with the ground, a stroke of lightning upon the wires will leap across to these conductors, and pass harmlessly to the ground, while the artificial current possesses too little intensity ever to overcome the intervening space, and continues in the circuit. Similar arrangements are provided upon many telegraph lines. The telegraphic fire alarm has now been introduced into all the larger cities. The fire alarm telegraph of Boston is employed to designate the exact noon by a single stroke upon the bell of the Old South church, an exact chronometer being placed in the circuit and arranged so as to pass the current at 12 o'clock precisely. By a similar arrangement in London a large ball is made to drop exactly at 12 o'clock from a pole erected in the Strand by the action of a current from the royal observatory. The same thing is also done at Nelson's monument, Edinburgh. In Paris a cannon is fired upon a similar plan. Chro-

nometers in observatories are also made to run synchronously with a standard instrument by means of the electric current. Recently, the Harvard college observatory has established a telegraphic connection with Boston, and thence with the lines which diverge from that city, so that a uniform time can be distributed to all the railroad stations in New England. In a similar way Greenwich time is given to the whole of Great Britain. The application of the telegraph to the determination of longitudes has been described in the article Coast Survey, vol. iv., p. 759. Upon some railroads the telegraph is used with great advantage for regulating the running of trains. In numerous places telegraphs have been constructed for private purposes, and in London from the house of commons to the committee rooms. The transactions of the stock exchange in New York are telegraphed to the brokers' offices and the hotels, and are instantly and simultaneously made known in a thousand different places, where they are sometimes recorded by automatic printing instruments. For this purpose a very rapid printer has been devised. The usual type and escape wheels are made very light, and are rotated, not by electricity, but by a spring. The current is reversed at every vibration, and the printing is effected by the power of a magnet, which is included in the same circuit with those that liberate the escape wheel; but it is made more sluggish in action so that it does not perform its work until the arrest of the circuit wheel at a letter gives time for it to be charged. This instrument, which occupies only one sixth of a cubic foot of space, will print 800 letters a minute.—A system of telegraphs for the use of large cities was devised by Wheatstone, by which a company leases the use of a small wire by the year to individuals. For distances not exceeding 20 m. a copper wire no larger than a cotton thread is sufficient. Numbers of these, insulated by being wound with thread, may be brought together into one cord, and suspended from strong iron wires passed in different directions upon the houses. The latter, communicating with the ground at numerous points, will convey away all atmospheric discharges that might otherwise be troublesome. The "Law Telegraph Company" in the city of New York has established a complete system of communication by means of dial instruments between the leading law firms and the courts. A rapid system of signalling is used, by which any member of the company can be put, through the agency of a central office, into direct private communication with any other member, or with the courts of New York or Brooklyn. The Chester dial is employed by this company. In the automatic fire alarm, a circuit is closed by the expansion of metal under a rising temperature. The circuit closer, which is called a thermostat, is attached to the ceilings of stores or dwellings, and is adjusted to work at a fixed temperature. In the city of New York houses and stores furnished with these instruments are connected telegraphically with the fire patrol, the usual apparatus for indicating the locality of the fire being included in the system. The district telegraph system, which has been introduced in New York, Boston, and elsewhere, by which a messenger, policeman, or fireman can be summoned to any house that adopts it, is a still wider extension of Wheatstone's scheme. On a smaller scale, telegraphic communications may be kept up between the remote quarters of a ship or yacht; the electro-magnetic bell-ringer may be used for domestic purposes, and the burglar alarm for the protection of private dwellings. By means of Batchelder's electro-magnetic tell-tale clock, the times are recorded when a watchman visits the different points of his beat. The most difficult piece of music may be punched out upon a moving strip of paper, and then played automatically by means of electro-magnetism. On the field of battle, telegraphic lines may be quickly extemporized, and an interchange of reports and orders may be maintained between the outposts of an army and headquarters. During the American civil war, telegraphic field trains were in use. A machine has been invented, operated by keys, which enables a reporter to secure a printed copy of the very words which come from the mouth of the orator. In some countries, as in England, where the lines have been purchased by the government, the telegraphs are associated with the postal service. For short distances the pneumatic telegraph is used, the written messages being driven through underground pipes by condensed air. For this purpose three engines of 50 horse power each are in constant service at the central post office in London.—*Multiple Telegraphy.* During the last quarter of a century various attempts have been made to contrive ways by which two messages should be sent at the same time, in the same or in opposite directions, over a single wire. Gintl, Edlung, Wartmann, Frischen, Siemens, Halske, Duncker, Starke, Rouvier, Zantedeschi, Farmer, and Stearns have all experimented with this object, and some of them have invented ingenious instruments. In 1849 Siemens and Halske took out a patent in England for a method of transmitting simultaneously a plurality of messages. In 1855 Starke devised a method of sending two messages at the same time upon the same wire. By means of two keys, and two batteries of different intensities, two independent receiving magnets were worked at the other end of the line, either separately or together. In 1854 Siemens and Halske independently invented the differential method of sending two messages at the same time in opposite directions. About the same time Farmer devised a way of doing the same thing, using two auxiliary batteries in combination with two principal batteries. The essential conditions for successful duplex tele-

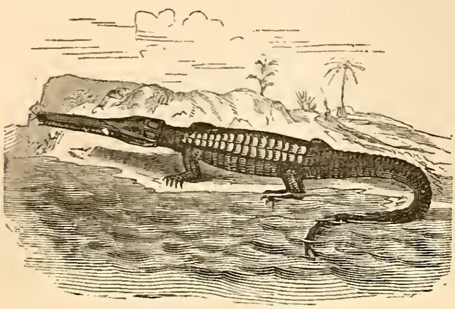
graphy are: 1, that neither key should put in action the receiving magnet at its own end of the line; 2, that in all positions of the key signals should be sent through a line of constant length and capacity. This is done by dividing the current from the battery at each end of the line equally between the line itself and an equivalent resistance coil and condenser, and winding the wire round the receiving magnets in such a way that the two parts of the current produce equal and opposite magnetism in the core of soft iron. The modifications made by Stearns in the arrangement of Siemens and Gintl have obviated all the practical difficulties, and made duplex and even quadruplex telegraphy a success in the United States. By means of Stearns's invention, known as the Franklin, the duplex system has gone into effect, not only between Boston and Washington, but also between Cape Breton and San Francisco, and has been introduced into England. The quadruplex system works well between Boston and New York. The phonetic system of Gray and Bell (which is still in its infancy) aims to increase indefinitely the number of messages which can be sent simultaneously over a single wire, by using tuning forks, moved by electro-magnets, for sending and receiving the signals. Only one fork at the receiving station is in unison with a particular fork at the sending station, and responds to it. Experiments upon a similar system were made by Paul la Cour in Copenhagen on a line of 242 m. in 1874, an account of which was presented to the royal Danish academy of sciences. It was thought that by this arrangement not only many messages could be sent at the same time on a single wire, but also a message could be received only by the station for which it was intended. —See Schellen, *Der elektromagnetische Telegraph* (Brunswick, 1850); Moigno, *Traité de la télégraphie électrique* (Paris, 1849); Highton, "The Electric Telegraph, its History and Progress," a number of Weale's series (London, 1852); Jones, "Historical Sketch of the Electric Telegraph" (New York, 1852); Turnbull, "The Electro-Magnetic Telegraph" (Philadelphia, 1853); Schaffner, "Telegraph Companion" (2 vols., New York, 1854-'5), and "The Telegraph Manual" (1859); Prescott, "History, Theory, and Practice of the Electric Telegraph" (Boston, 1859); Dumoncel, *Télégraphie électrique* (Paris, 1864); Field, "History of the Atlantic Telegraph" (New York, 1866); Griscom, "The Telegraph Cable" (Philadelphia, 1867); Sabine, "The Electric Telegraph" (London, 1867); Cully, "Handbook of Practical Telegraphy" (New York, 1870); Goldsmid, "Telegraph and Travel, a Narrative of the Formation and Development of Telegraphic Communication between England and India" (London, 1874); and Douglas, "A Manual of Telegraph Construction" (1875).

**TELEKY, László**, count, a Hungarian statesman, born in Pesth, Feb. 11, 1811, died there, May 8, 1861. He studied at Pesth and Patak, wrote a drama, *Kegyencz* ("Favorite"), and became a leading opposition member of the diets of Transylvania and Hungary. In September, 1848, he went as envoy of the Hungarian government to Paris, where he published *Le bon droit de la Hongrie* (1849). After the close of the Hungarian war he resided mainly in Paris. During the war of 1859 he was a member of the Hungarian national committee in Italy, and in 1860 went to Dresden, where he was arrested and surrendered to the Austrian government. Francis Joseph restored him to liberty on the promise of severing his connection with the Hungarian refugees and abstaining from political agitation. After a few months, however, Teleky accepted an election by his former constituents to the house of representatives. The diet was opened April 6, 1861. The debate on the address to the monarch, prepared by Francis Deák, was to open on May 8, and Teleky, the leader of the radicals, who opposed any measure looking like a recognition of Francis Joseph as king of Hungary, prepared an elaborate discourse on the situation. This was found on his desk on the morning of the 8th, and near it on the floor the dead body of the writer, whom, as various indications showed, dissatisfaction with his own course had led to end his life by a pistol shot.

**TELEMACHUS**, a legendary Greek prince, son of Ulysses and Penelope. When Ulysses went to Troy, Telemachus was an infant. About the time for the father's return the son made an unsuccessful endeavor to eject the suitors for his mother's hand, and then set out to seek information of his father. Accompanied by Minerva, in the guise of Mentor, a faithful friend of Ulysses, he visited Pylos and Sparta, and was kindly received by Nestor and Menelaus. Returning home, he found his father with the swineherd Eumæus, disguised as a beggar, and aided him in slaying the suitors.

**TELEOSAURUS**, a genus of fossil crocodilians of the secondary epoch established by Geoffroy, differing from the living crocodiles in having biconcave vertebræ. The general form of the cranium was that of the gavials; the nostrils opened anteriorly at the end of the muzzle and posteriorly on a level with the jugal arch; the lower jaw was spoon-shaped at the end, with teeth on the sides like canines, the other teeth being small, equal, conical, and adapted for seizing a fish prey; the body was protected by larger and more solid plates, the anterior limbs were smaller, and the posterior more fin-like than in the present crocodilians. The strata which enclose their remains indicate a marine habitat. The genus has been divided by modern palæontologists into several subgenera, as given by Pictet. In the lias is found *mystriosaurus* (Kaup), having a very long muzzle, flattened head, and eyes directed upward. The *T.* (*M.*) *Chapmanni* (König), from the upper lias of Yorkshire, England, is described in the "Philosophical

Transactions" of 1758; the vertebræ were 64, 16 being dorsal, and the teeth about 70 in each jaw; some of the dermal plates were 3½



Teleosaurus Cadomensis.

in. in their transverse diameter; it attained a length of about 13 ft. The name has been generally restricted to the species found in the oölite, especially the *T. Cadomensis* (Ét. Geoffr.), or crocodile of Caen, from the limestone of Normandy. This is characterized by large orbits near together, a flattened muzzle five times as long as wide, very long transverse processes of the dorsal vertebræ, and thick rectangular scales forming 10 regular series, each containing 15 or 16; it must have attained a length of 20 ft.

**TELEPHONE** (Gr. τῆλε, afar, and φωνεῖν, to speak), an apparatus for transmitting sounds to a distance, through the agency of electricity. The principle of the magnetic telephone depends upon two things: 1, that a thin soft-iron plate, placed in a confined position, as in an artificial ear, will be thrown into vibrations by sound waves, just as the tympanum of the natural ear is affected by similar waves; and 2, that if these vibrations are produced near one end of a steel magnet around which an insulated wire is coiled, a magneto-electric current will run through the wire each time that the iron plate approaches and recedes from it. If this wire be carried to a distance and coiled around a second magnet, the electric current thus induced will simultaneously affect the magnetism in it; and if a thin iron plate, similar to the first, be placed near its end, in the same relative position as the one in front of the first magnet, the vibrations of the first plate will be reproduced in the second. To recapitulate: In the human ear sound waves induce vibrations in the tympanum, and these vibrations are conveyed to the auricular nerves through a series of small articulated bones. In the telephone similar waves cause vibrations in a soft-iron disk, called the diaphragm; these vibrations induce electric currents, which, passing through wires, cause tremors in a second magnet, and these reproduce in a second diaphragm the original vibrations, which carry to the tympanum of the listener the exact sounds which produced the vibrations. As the instruments at each end of the wire are precisely alike, the action is reciprocal, and sounds may be conveyed in either direction. The construction of the telephone will be best understood by a reference to the diagram, fig. 1. In this, *b b* represents the section of a thin tube, made with a flange which bends outward. Next to this flange is a thin iron plate, *c c*, which constitutes the diaphragm of the instrument, and which is thrown into vibrations by the sound waves. A wooden ring or washer, *d d*, is placed next to this, and upon it a spool-shaped tube, *e e*, just large enough in the barrel to admit the magnetized steel rod *g*. The parts may be screwed up tightly together, by means of the screws *h h*. The mouthpiece, *a a*, is shaped like a funnel, so that the voice may be concentrated on a small part of the diaphragm. Around the spool is wound about 50 yards of fine silk-covered copper wire, the ends of which are joined to the line wires, *f f*. These connect with another precisely similar instrument at a distance from the first. To operate the telephone, the magnet is pushed in until it nearly touches the diaphragm, *c c*. Any sound now made in the mouthpiece, *a a*, causes a vibration in the diaphragm, *c c*, which is communicated to the magnet, and through it to the wires. The latter convey the thrill to the magnet of the second instrument, which in turn causes vibrations in its diaphragm, and this reproduces the sound waves which caused the vibrations in the first instrument. Thus the sounds made in the mouthpiece of the first instrument are conveyed over miles of wire, and reproduced so accurately by the second instrument that the words of a speaker may be distinctly heard, and even the tones recognized. Conversation has been carried on through the telephone by persons 300 miles apart. Sounds have been conveyed much further; but beyond that distance the articulation is so indistinct that words are unrecognizable. In using the telephone, the instrument is held close to the lips, and the speaker talks loudly and distinctly into the mouthpiece. The words are repeated at the other end of the circuit with the same pitch

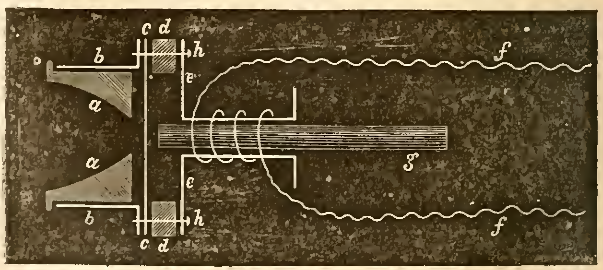



Fig. 1.

and cadence, even the character of the speaker's tones being so faithfully reproduced that voices are easily distinguished; but the tones are in a measure ventriloquial, and seem to come from a great distance. No previous training is required to enable any one to use the telephone. The instrument has merely to be held to the ear to enable the operator to hear distinctly any message sent from the other end. The same instrument is then placed to the mouth and the answer returned. To facilitate the transmission and reception of messages, two instruments are generally used by each operator, one of which may be held to the ear and the other used for speaking. If several telephones are connected with one wire, the sounds sent over the circuit are reproduced by each, so that any number of persons may listen to the same message; many sounds may also be transmitted at the same time, like the singing of the different parts of a song, in which case each performer sings into a separate instrument. The tones of a musical instrument, or of a collection of instruments, may be conveyed and reproduced in the same manner. A telephonic concert was given in Steinway hall, New York, April 2, 1877, in which all the music, instrumental and vocal, was executed by performers in Philadelphia, and transmitted over the ordinary telegraph wires.—The principle of the telephone has long been known; all that is new about it is its adaptation to practical uses. Electric telephones, devised not long after the introduction of the telegraph, were capable of conveying to a distance musical tones; but the other characteristics of sound, intensity and quality or *timbre*, were entirely wanting. In 1837 Prof. Charles G. Page, of Washington, discovered that the rapid magnetization and demagnetization of iron bars produced a molecular change of sufficient intensity to cause a sensible sound. De la Rive, of Geneva, increased these musical effects in 1843, by operating on long stretched wires. In 1854 Charles Bourseulle, under-inspector of the telegraphic lines at Auch, France, suggested the practicability of transmitting speech by electricity in almost precisely the way in which it has been accomplished by the telephone of to-day; but, although his plan was published in the Count du Moncel's *Exposé des applications de l'électricité*, it does not appear to have been tested practically. The first to utilize Page's discovery was Philip Reis, of Friedrichsdorf, Germany, who in 1861 constructed a telephone in which a vibrating diaphragm was caused to make and break a galvanic circuit. Reis's apparatus reproduced the tone or pitch of sounds, so that the successive notes of a melody could be distinctly recognized; but they were all of the same intensity, because the currents which formed them were all of the same strength. It was therefore only a philosophical toy, and of no practical value. In 1873 Elisha Gray, of Chicago, produced what he called his "resonator." By attaching organ pipes to this, the sounds were magnified, and he was able to fill a large hall with music played 100 to 200 miles away. Gray also proved the practicability of transmitting composite sounds, such as chords, to a distance. By his apparatus the intensity as well as the pitch of sounds was reproduced; but it was reserved for Alexander Graham Bell, of Boston, to discover a method by which all the characteristics of sound, pitch, intensity, and quality, could be transmitted. This rendered possible the reproduction at a distance of human speech with all its modulations. The telephone exhibited by him in Philadelphia in 1876 was worked with an electro-magnet, but he subsequently adopted a permanent magnet. An external and a sectional view of the Bell telephone are given in figs. 2 and 3. The instrument is about 6 in. long, $2\frac{1}{3}$ in. in diameter in its widest part, and 1 in. in diameter in the tube. The tube F, fig. 3, which is made of hard rubber, contains the magnet A, whose distance from the diaphragm, E E, is about $\frac{1}{32}$ of an inch. The magnet used in the latest form of the instrument is a square compound magnet, $4\frac{1}{2}$ in. long and $\frac{1}{2}$ in. in diameter, formed of three pieces riveted together. On the end next to the diaphragm is fitted a wooden spool, about $\frac{1}{2}$ in. long, wound with fine silk-covered copper wire to 60 ohms. A section of this is shown at B. The ends of the wire are continued through C C to the binding screws D D, where they connect with the line wires. The diaphragm is a circular piece of ordinary photographer's plate, used for ferrotypes, and is varnished on both sides, to prevent

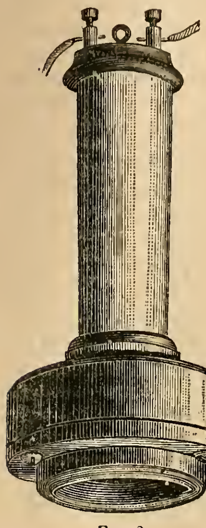


Fig. 2.

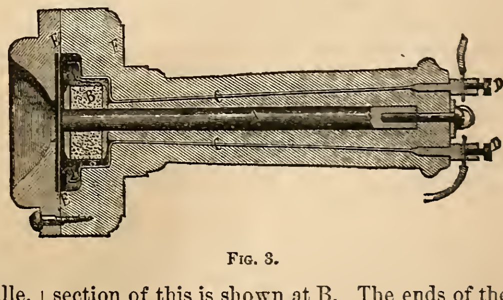


Fig. 3.

its rusting from the dampness caused by the breath. Mr. Bell has received two patents in the United States for the telephone, one bearing date March 7, 1876, and the other Jan. 30, 1877; and his instrument is now in practical use in many cities in this country and in Europe. Among others who have made extensive experiments in the transmission of sounds to a distance are Prof. A. E. Dolbear, of Tufts college, Massachusetts; G. M. Phelps, of New York; and Thomas A. Edison, of New Jersey, the inventor of the phonograph (see PHONOGRAPH). The Dolbear telephone is essentially the same as the present form of the Bell instrument, and was devised by its inventor in the autumn of 1876 without any knowledge of the mechanism used by Bell. Prof. Dolbear claims that he was the first to utilize magneto-electric currents for the transmission of speech. The Phelps instrument is also the same in principle, but differs in exterior form. In the Edison telephone the diaphragm is made to vibrate against a disk of carbon, which forms a part of an electric circuit, the current of which is generated by a two-cell battery. The resistance of this disk varies in accordance with the pressure on the diaphragm, and occasions a proportionate variation in the strength of the current, which is thus made to reproduce all the characteristics of vocal waves.

**TELESCOPE** (Gr. τῆλε, far, and σκοπεῖν, to view), an instrument for aiding the eye in viewing distant objects. The general construction of the telescope is based upon the property possessed by a convex lens or concave mirror of converging to a focus the rays of light falling upon it from any object, and of forming at that focus an image of the object itself. This image may be rendered visible, as in the camera obscura, by interposing at the focus a white screen, a plate of ground glass, or a cloud of light smoke within which the image will appear suspended. But if the rays be allowed to proceed without interruption, and the eye be placed in the axis of the lens or mirror and at the proper distance from the focus, the image will be seen more distinctly than before; and if the focus be nearer to the eye than to the lens, the apparent dimensions of the image will be greater than the apparent dimensions of the object itself. This is the simplest, though not the common form of the telescope. Usually a second lens,

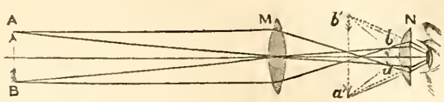


FIG. 1.—Astronomical Telescope.

of shorter focus than the first, is introduced near the image, the effect of which is to increase still further the apparent magnitude of the object; and thus is constituted the ordinary telescope, which in its elementary construction consists of an "object glass" or "object mirror," of as large dimensions as practicable, and an "eye lens," which enables the eye to receive the image under the greatest practicable angle. In fig. 1, M is the object glass and N the eye lens. The inverted image $b\ a$ of a distant object A B is formed between the eye lens and its principal focus, and the eye lens then gives a magnified image of it, $b'\ a'$. The object glass is always necessarily convex, and the mirror concave, but the eye glass may be either; if convex, it is placed at the proper distance beyond the focus, and, the rays having crossed, the image then appears inverted; if concave, as in the common opera glass, it is placed within the focus, and objects appear in their natural position. The magnifying power of the instrument is measured by dividing the focal distance of the object glass by that of the eye piece; the illuminating

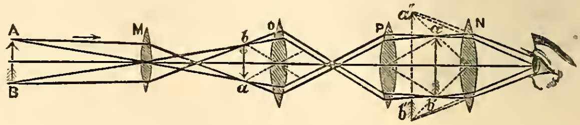


FIG. 2.—Terrestrial Telescope.

power depends mainly on the size of the object glass. In the terrestrial telescope, commonly called spy glass, the image is produced in its natural position. To effect this two additional lenses, O and P, fig. 2, called condensing glasses, are introduced between the real image and the eye lens. The object A B produces an inverted and smaller image at $b\ a$. The lens O being at the distance of its principal focal length from $b\ a$, the rays which fall on P will be parallel, and the image $a'\ b'$ in the principal focus of P will be erect, as will also be the magnified image $a''\ b''$.—It is believed by many authorities that the theory of both the telescope and the microscope was known to Roger Bacon, and the telescope is said to have been used by Digges before the 17th century; but the first really definite accounts of the invention date from the latter part of the year 1608. Magnifying lenses had long been known, and even the compound microscope had been invented by the Jansens nearly 20 years before this date; a discovery which has somewhat embarrassed the study of the question before us from confusion of the by no means explicit terms in which both instruments are described. But it is now generally conceded that the honor of making the first telescope belongs to one of two individuals, Hans Lippersheim, a spectacle maker in Middelburg, and Jacob Adriansz, called also Metius, a native of Alkmaar. Lippersheim, on Oct. 22, 1608, presented to his government three instruments with which "one could see things at a distance," applying at the same

time for a "protection" or other equivalent for a patent. Metius made a similar present and a similar application later in the same month, but said that he had manufactured such instruments two years before. It has been frequently said that Zacharias Jansen also invented the telescope more than a year later; but the evidence adduced only proves, according to Olbers, that he made telescopes which may have been imitated from those of Lippersheim; and this is the more likely as both were spectacle makers in the same city, and it is hardly possible that the public transaction with the latter could have escaped the knowledge of Jansen. The attempt was made by the states general, it is said, to retain to themselves the knowledge of this invention, the importance of which in war was at once perceived by Prince Maurice; but it is also believed that the French ambassador soon obtained from them an order for two telescopes for his own government. It is certain that the report of the invention soon spread abroad, and the instruments found their way to London, Paris, and Venice. But by no one was the idea more eagerly welcomed, or its great importance more quickly recognized, than by Galileo, then visiting Venice. He was evidently willing, at a later day, to be thought the second inventor, guided only by an uncertain rumor; but it is said that he actually saw one of the Dutch telescopes. Returning to Padua with some lenses, he immediately began to improve upon what he had seen, if not to experiment independently under guidance of the mere report, and he soon found a better and more certain result than had been chanced upon by the original inventor. He made a leaden tube, and fitted at one extremity a double convex lens for object glass, and at the other a double concave for eye piece. This, his first telescope, magnified only three times; he then made another of more than double this power, and soon after, with a magnifying power of 30, he began to study the heavens, where his first discoveries excited more wonder than that of the "optic glass" itself. The popular curiosity was so great, as he himself tells us, that he was compelled night after night to stand by his glass to show its wonderful performances. The phases of Venus, questioned hitherto, were revealed to sight; the satellites of Jupiter and the oblong shape of Saturn were distinctly seen; the lunar mountains were measured; spots were found upon the sun's disk; and the milky way was resolved into stars. The Galilean telescope produces an erect image. The object glass A B would form an inverted image at $b\ a$, fig. 3, but the concave eye lens N refracts the rays, which being produced backward forms an upright image at $a'\ b'$. In 1609, the same year in which Galileo's telescopes were made, others found their way into England, and were soon sought after with an avidity that was stimulated by the report of Harriot's discoveries. This young astronomer made drawings of the moon, discovered the satellites of Jupiter, and observed the spots upon the sun. The new "cylinders," as they were called, were soon in general use, and were exposed for sale in Paris in the early part of the same year. These first telescopes are supposed to have been all made with a concave eye lens. Kepler in 1611 suggested the use of a convex eye lens; but the first actual application of one was made by the capuchin Schyrle de Rheita, who describes it in his work *Oculus Enoch et Eliæ* (1645). This eye lens gives a much larger field of view, but shows objects inverted. On the other hand, the Galilean telescope had the advantage of greater distinctness and brightness than was found in the "astronomical" form. The true cause of this advantage is now known to lie in the partial compensation by the negative eye piece of the aberrations caused by the object glass, the result being in this case the difference, while in the astronomical telescope it is the sum, of the aberrations of the two lenses. Rheita invented also the binocular or double telescope, a construction which frequently recurs afterward, but always as a thing of curiosity rather than of practical utility until in modern days, as the double opera glass or lorgnette, it has become serviceable in reconnoissances, terrestrial and celestial.—The very first attempts to gain magnifying power and light by enlarging the object glasses of telescopes, revealed a most unexpected and formidable obstacle. It was found that all objects appeared strongly tinged with prismatic colors. This obstacle remained unexplained until the time of Newton, and unconquered more than half a century longer. But if at the time insurmountable, it did not prove unavoidable, for it was ascertained that by making the focal distance of the object glass very great in proportion to the diameter, the colored fringes could be rendered practically imperceptible. Enormously long telescopes were therefore constructed, and it was with them that the brilliant discoveries of that time were made. Huygens used telescopes of his own manufacture, and one of his object glasses, 123 ft. in focal length, is still to be seen in the library of the royal society of London. English makers also produced telescopes of nearly equal dimensions, and Auzout in Paris spoke of surpassing all others, but it does not appear whether he succeeded. The elder Campani, at Rome, made lenses of from 70 to 136 ft. focus, and with these Cassini discovered two of the satellites of Saturn. Cassini also used

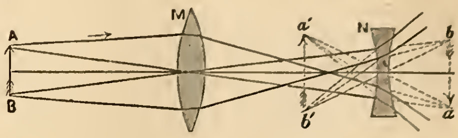


FIG. 3.—Galileo's Telescope.

other lenses made by Borelli of 40 and 70 ft., and by Hartsoeker of not less than 250 ft. focus. These object glasses were used without any tube, the lens being placed upon a mast, or, as Cassini recommended, at the angle of a tower, and controlled, not without considerable difficulty, by cords leading to the observer at the eye lens.—The source of the inconveniences attending the use of shorter lenses was generally supposed to lie wholly where it did really lie in part, in the imperfect collection of the rays of light, which were at that time believed to be homogeneous, into a simple focus. It was distinctly understood that the rays which passed through a lens near its centre would not be refracted to precisely the same point with those which pass through it near its circumference; that is, there would be what is technically called spherical aberration. This is a true cause, but by no means the whole cause of the indistinctness of images in the telescope. Accordingly, with that belief, it was thought the evil might be remedied by grinding lenses with other surfaces than spherical, and machines were devised by Descartes, by Hevelius of Dantzic, by Du Son of London (who ground deep parabolic concave lenses, with which he asserted that telescopes might be used "with full aperture," and yet show no colors), by Sir Christopher Wren, and others. But the main reliance of the astronomer until near the close of the century was in the aërial telescope, with which, unwieldy as it was, many brilliant discoveries were made.—An improvement, of more importance than that of the figuring of lenses, consisted in the modification of the eye piece. By the introduction of more than one convex lens, Rheita had reinverted the image; but this was all the gain that either he or Kepler, who also proposed the same thing, seems to have expected. In fact, there was an increase of aberrations which caused distaste for the plan, and it was not until about 1659, when Huygens invented the combination which still bears his name, that much advantage was gained by multiplying lenses. This eye piece is composed of two convex lenses whose focal lengths are as 3 to 1, which are separated from each other by an interval equal to half the sum of these focal lengths, the place of the telescopic image being between the lenses. This arrangement was found to have a remarkable advantage in point of distinctness over the single eye glass, by reason of the apportionment of spherical aberrations between the lenses, and the consequent less amount of injurious effect in the result, while no addition whatever was made to the color of the images formed by the object glass. To this day the "Huygenian eye piece" remains one of the best combinations for ordinary viewing purposes. Another eye piece, less successful, was constructed by Campani with three lenses so arranged as to show objects "without any iris or rainbow colors."—The refracting telescope remained full three quarters of a century without further material improvement. Morin, professor of mathematics in the collége de France, first in 1634 attached a telescope to the moving index of a graduated arc, in order, as he says, "to measure the fixed stars quickly and accurately." He was also the first to gain sight of stars in the daytime. But it was only after the introduction of fixed threads into the field of the telescope that it became a really useful auxiliary to instruments of measurement. At the present day it seems at first strange that astronomers should have preferred the simple "sights" or "pinnules," with which they had always been accustomed to observe, to the far more accurate perception furnished us by the telescope; and yet they, without any means of designating the centre of the field of view, and with only the feeble optical power at their command, were right in their preference. Even as late as 1673, Hevelius argued earnestly in favor of the pinnules for observing, from a want of confidence in the new method. As early as 1641 Gascoigne, an accomplished young English astronomer, had applied fixed threads to the telescope, and had also invented the wire or filar micrometer. He perished at the battle of Marston Moor, and his invention, of which no account had been published, remained forgotten until nearly 30 years after, when an opportunity for reclamation occurred upon the reinvention of the micrometer by Auzout. About the same period Roemer gave to the telescope one of its most important applications, by attaching to it an axis at right angles to its length, and placing it so as to revolve in the plane of the meridian; and shortly afterward Picard in Paris and Flamsteed at Greenwich, following up this idea, commenced a new era in observation. (See Transit Circle.)—Mersenne, in his correspondence with Descartes, had before 1639 suggested the practicability of using a concave mirror instead of the principal lens in the telescope. In 1663 James Gregory of Edinburgh published, in his *Optica Promota*, the plan of a reflecting telescope, consisting of a concave mirror, perforated in the centre, by which the rays were to be converged to a focus before it, and after crossing would be received upon a second small concave mirror, be reflected back by the latter, and, crossing again near the opening in the first reflector, would be there received by a lens and transmitted to the eye. The rays having crossed twice, objects would appear in their natural position. An unsatisfactory attempt was made to construct such a telescope. Newton now took up the study. He soon found the true cause of the prismatic colors, and concluded "that the perfection of telescopes was hitherto limited, not so much for want of glasses truly figured according to the prescriptions of optic authors, . . . as because that light itself is a heterogeneous mixture of differently refrangible rays. So that, were a glass so exactly

figured as to collect any one sort of rays into one point, it could not collect those also into the same point which, having the same incidence upon the same medium, are apt to suffer a different refraction." Thus he was led "to take reflectors into consideration," since here there would be no separation of colors; but inasmuch as any irregularity of figure in a concave mirror would produce greater distortion in the image than would be the case with a lens, "a much greater curiosity [nicety] would be requisite than in figuring glasses for refraction." The Gregorian construction, mentioned above, appeared to him to have such disadvantages, that he "saw it necessary to alter the design, and place the eye glass at the side of the tube." Having then found an alloy of copper and tin which appeared to possess the requisite qualities for mirrors, and having also devised a "tender way of polishing proper for metal," he attempted the construction of a reflecting telescope upon the plan which has ever since borne the name of Newtonian, and soon produced an instrument with which he could discern the "concomitants" of Jupiter and the phases of Venus. Another one made soon after (1671),

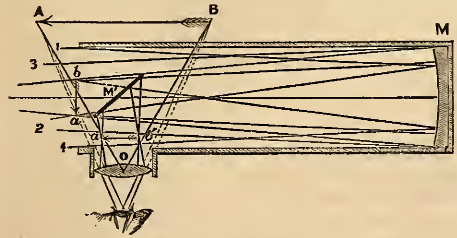



FIG. 4.—Newton's Telescope.

having a speculum of $1\frac{1}{8}$ in. diameter and $6\frac{1}{3}$ in. focus, was presented by him to the royal society of London, by whom it is still preserved. In these telescopes the mirror M, fig. 4, is at the lower end of the tube, the mouth of which is directed toward the object to be observed. The rays 1 and 2 from one end of the object being reflected toward *a*, and the rays 3 and 4 from the other end toward *b*, an inverted image of the object would be formed at *b a*; but a small plane mirror M′, interposed at an angle of 45°, diverts the image to *a′ b′*, and the eye lens O magnifies this into A B. In the same year that Newton's new telescopes were made, Cassegrain, a Frenchman, proposed still another construction. The large mirror was perforated, but the rays proceeding from it were, before reaching their focus, received upon a small convex mirror which sent them back with less convergence to form the image near the eye piece. It was asserted that this form, which like Gregory's was not immediately brought into use, would possess several advantages over the Newtonian; but the English philosopher showed that these advantages were rather objections, and that the difficulty of properly working the mirrors would always be a serious obstacle to their general acceptance. In fact, we hear little more of them until 70 or 80 years later, when Short, a celebrated artist of Edinburgh, revived their manufacture, and, by his peculiar skill in figuring and mutually adapting the mirrors ("marrying them," as he termed it), brought them into favor for a time. But practical difficulties, especially in the manipulations of the large speculum, interposed for many years to prevent even the Newtonian construction from coming into general use. It was known indeed that in order to reflect all the rays accurately to the same focus, the figure of the mirror should be not spherical but parabolic; but no method was known whereby this figure could be attained with certainty. At length, in 1718, Hadley made a mirror 6 in. in diameter and with a focal length of 62 in., which bore a magnifying power of 230. This instrument may be considered to have established the reputation of reflectors; for on being compared by Bradley and Pound with the 123-foot aërial telescope of Huygens, it proved fully a match for the refractor, except that the latter showed objects somewhat brighter. After this period reflectors came rapidly into general use, and have ever since been the favorite kind of telescope in England. Their construction was greatly facilitated to practical men by the appearance in 1777 of an elaborate memoir by Mudge, giving a detailed account of his process of making and finishing specula. Another important memoir upon the same subject, by the Rev. John Edwards, was published in the appendix to the "British Nautical Almanac" for 1787. (See SPECULUM.)—About 1766 a small telescope, only 2 ft. long, fell into the hands of a German organist residing in Bath, England. He sent to London for a larger instrument, and, finding its cost too great, undertook to make one for himself. That organist was the elder Herschel. He devoted all the time at his command to the manufacture of reflectors. Improving continually upon his successive results, and with increasing means at his disposal, he made many Newtonian reflectors, some even as large as 20 ft., as well as several of the Gregorian form of 10 ft. focus. His discovery of the planet Uranus, in 1781, brought him to the notice of George III., by whose liberality he was enabled in 1785 to undertake the construction of the celebrated 40-foot reflector, which was pronounced fin-

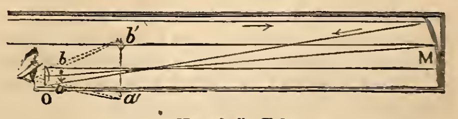



FIG. 5.—Herschel's Telescope.

ished in August, 1789; but it never accomplished any work worthy of its dimensions. In it the mirror M, fig. 5, was slightly inclined,

so that the image of the object was formed at $b\ a$, near the eye lens O, which magnified it into $b'\ a'$. It is commonly said that the sixth satellite of Saturn was discovered with it; but this is a mistake, the satellite having been in reality detected with one of Herschel's 18-inch reflectors. After the lapse of 50 years, during the latter portion of which the telescope had lain unused, it was dismounted by Sir John Herschel at the end of 1839, and on New Year's eve his family assembled within the tube and sang its requiem. It now rests horizontally upon three stone pillars, a monument to the memory of its constructor.—Newton evidently conceived that the prismatic rays of light, once separated, could not be recomposed into white light except by the same refraction that had separated them, and that therefore the removal of these colors from a telescopic image was impossible. The weight of Newton's authority was sufficient for a time to repress further investigations in this direction; and it was not till 1729 that an Englishman named Hall, guided, it is said, by a study of the mechanism of the eye, was led to a plan of combining lenses so as to produce an image free from colors. Telescopes were made according to his directions, and were said to perform well; but the secret of their construction died with him, and no public account of the facts was given until called forth by later occurrences. In 1747 Euler, referring to the construction of the human eye, declared that a combination of lenses of different media was possible which should give a colorless image, and investigated analytically the curvatures for a lens compounded of glass and water. His result was questioned by the man from whom opposition might have been least expected, John Dollond, who, relying too implicitly upon Newton's dictum, was contending against his own future fame. But he was soon led to consider the subject more attentively by the remark of a Swedish mathematician, that there were certainly some cases to which Newton's rules did not apply. He undertook experiments, at first with prisms of glass and water, and soon found that when the prisms were so combined that the rays passed through without refraction, they were tinged with the colors; next, arranging the prisms so that the rays appeared without colors, he found them displaced by refraction. He arrived at the same results by using prisms of crown and flint glass. From prisms to lenses the transition was easy, and his triumph was finally completed, when, having combined a convex lens of crown glass with a suitable concave of flint, he was able to correct the colors and leave sufficient refraction outstanding to produce a telescopic image. Euler still believed all kinds of glass alike in their optical properties, and that it was only some happy combination of curvatures at which Dollond had arrived; but his doubts soon gave way before experience, and the masterly powers of his analysis were brought to bear successfully upon the problem of the compound object glasses. The subject attracted universal attention, and mathematicians everywhere contributed toward perfecting by theory the requisite conditions of curvature of the lenses. The new telescopes were called achromatic, or free from color, and henceforth the "dispersive power" of any medium, by virtue of which the differently colored rays are differently refracted (that is, are dispersed from each other), was recognized as independent of the "refractive power," by virtue of which the whole pencil is diverted from its original source. Attempting, in 1758, to make double object glasses of short focal distance to be used with a concave eye lens, Dollond found difficulties in the management of the spherical aberration, and thereupon the idea occurred to him of dividing this aberration by having two lenses of crown glass and including the flint lens between them; an arrangement which accomplished the purpose in view, but did not succeed with convex eye pieces also. His son Peter resumed these experiments, and presented to the royal society of London a triple object glass of 3½ ft. focal length and 3¾ in. aperture, with which the telescopic image was pronounced by Short, an excellent judge, to be "distinct, bright, and free from colors." A beautiful suggestion was made by Wollaston of a means of testing and correcting the concentric adjustment of lenses. By removing the eye glass of a telescope and viewing any bright object, as a lighted candle, through the object glass, there may be observed at the same time with the refracted image a series of fainter images formed by the second reflections from the different surfaces. It is evident, then, that if the glasses be truly centred, these images will all be in the same straight line; or if there be any error of position of either lens, it will be decidedly manifested, and by proper adjusting screws may be corrected accordingly.—Among the many mathematical solutions of the new problem of the object glasses were the precepts given by Klügel, in his "Dioptrics," viz.: 1, that the radii of curvature of the first, or crown lens, should be such that the angles of the incident ray with the normal would be equal at both surfaces, which would give for crown glass a ratio of nearly 1 to 3; 2, the radius of the third surface, the first of the flint lens, should be such that the rays of mean refrangibility passing through both the centre and edge of the lens would unite as nearly as possible in the same part of the axis, so that the spherical aberration would be sensibly destroyed; and 3, having determined the outstanding dispersion for the red and violet rays, the fourth surface should be made such as to unite these rays as nearly as possible in the same point with the rest. Early in 1816 Bohnenberger, commenting upon these precepts, showed that, by changing the ratio of the first two surfaces from $\frac{1}{3}$ to $\frac{2}{3}$, the proportion of aperture to focal length could be materially increased without prejudice to

the performance of the instrument. Not long afterward Gauss remarked that it was possible, theoretically, to construct an object glass which would unite all the rays of any two colors as well as the mean rays at the centre and at a given distance therefrom into one and the same point. Both lenses should be concavo-convex. With a proportion of aperture to focal length of $\frac{1}{13}$ he obtained an almost perfect union of rays. The unusually deep curvatures of the lenses seem to have occasioned some scruples on the part of opticians, and this construction remained almost forgotten for 40 years, until Steinheil found and conquered the practical difficulty, and in 1860 arrived at complete success in the manufacture of the Gaussian object glasses.—The proper construction of eye pieces was also a matter of some consideration. Besides the Huygenian form, which is only applicable for viewing objects, Ramsden in 1783 introduced another, which is still used in micrometer observations. It consists of two plano-convex lenses, of equal focus, with their convex surfaces toward each other, and separated by a distance of two thirds of the common focal length. By this arrangement, to which he was guided by a remark of Newton, the essential condition of a "flat field" is gained, and the aberrations, chromatic and spherical, are so much reduced as to be practically insensible. For terrestrial observations, the elder Dollond sought to reduce aberrations and enlarge the field of view by increasing the number of lenses, and, after improving the four-glass eye pieces already in use, obtained by adding a fifth lens a combination which very satisfactorily effected both the desired objects.—Joseph Fraunhofer studied the theory of light and the laws to which it is subject in transmission through various media, and solved the difficulty of procuring disks of homogeneous flint glass. The process by which his glass was manufactured is kept a secret, but it is generally understood that the disks themselves are obtained by selecting and melting together the most faultless specimens from larger masses of the best glass, whose constituent parts however are not known. Having now the glass, he well knew how to combine curvatures to suit its peculiar properties, and the results are to be found all over Europe. He completed in 1824 the splendid telescope for the observatory at Dorpat. The object glass of this instrument, double and not triple as sometimes stated, has a clear aperture of 9·6 in., and a focal length of 170·5 in. Its optical performance is of the highest character. It gave to the stellar images a perfect sharpness of definition, which enabled it not only to resolve the closest known double stars, but also to discover as double or multiple others that had passed unchallenged before the exquisite 20-foot reflectors and the practised eye of the younger Herschel. Fraunhofer's style of "mounting" the telescope remains to this day essentially unimproved.—The manufacture of optical glass has received much attention in England. In 1824 a committee was appointed by the royal society to take into consideration the theory and to experiment upon the manufacture of such glass. The chief labor devolved upon three members, G. Dollond, Faraday, and Herschel. The first results were reported to the society in 1829. The efforts of this committee were directed to the manufacture of very heavy glass, and they obtained disks of 7 in., which seemed, so far as tried, to answer all the requirements of the telescope. Dr. Ritchie also devoted much attention for several years to the same subject, and with considerable success, but was prevented by premature death from publication of any of his processes. Judging by the appearance of Ritchie's glass, Mr. Simms inferred that it had been fused in moulds and there subjected to pressure. The largest disk had 7¾ in. diameter, and was ground for use by Simms himself. It was found to be "an excellent glass, but not altogether faultless." The idea occurred to some that the desired achromaticity might be obtained by separating the lenses and placing the flint at some distance down the tube in the narrowing cone of rays. In 1828 Alexander Rogers proposed to introduce in combination with the crown lens a smaller compound lens of plate and flint glass, in which the refraction is entirely destroyed, and the outstanding dispersion left available for the desired correction of that of the outer lens. The investigation of the requisite curvatures of this compound lens was found to present no peculiar difficulty; and moreover the final perfection of the compensating action could be accomplished by proper adjustment of the relative positions of the lenses, so that less rigorous accuracy is requisite in their mechanical formation. Rogers found it probable that a telescope of 18 ft. focal length, with a crown lens of 12 in. aperture, could be made achromatic with a flint lens only 4 in. in diameter; and four years later this construction was introduced into use by Plossl at Vienna with much success. It received the name of "dialytic" or separated telescope. One of these telescopes, in the possession of Schumacher, having an aperture of 2¼ in. and focal length of 2 ft., was described by him as of extraordinary excellence of defining power. Struve compared a dialytic telescope of 3¼ in. aperture, bearing a magnifying power of 135, with a Fraunhofer telescope of half an inch greater aperture and a power of 210, and was scarcely able to perceive any superiority in the latter. Telescopes with lenses of rock crystal and glass were advertised to be made in Paris by Cauchoix in 1831, and some few came into favorable notice; but the difficulty of obtaining the materials in proper shape and size will be a permanent obstacle to their general manufacture. It had long been observed that, even in the best telescopes, there were residual colors hav-

ing their origin in the want of a perfect correlation of the colored spaces in the spectra formed by the crown and flint lens; so that if any two colors be made to unite at the same focus, as in ordinary object glasses, there would not be at the same time a complete union of the rest. This want of correlation is called the "irrationality" of the colored spaces, and its effect is called the "secondary spectrum." Dr. Blair, to overcome this effect, first made each of the lenses of his object glass independently achromatic, and in such a way that their secondary spectra corrected each other. This he accomplished by using fluid media, two lenses of which were enclosed in combination with three of glass. Moreover, in the course of his experiments, he discovered that muriatic acid combined in proper proportions with metallic antimony gave a spectrum in which the colors had exactly the same proportions as in crown glass; and therefore by enclosing this fluid between two crown lenses, one a plano-convex and the other a meniscus, he obtained a telescope absolutely free from colors. The name "aplanatic," or without error, was given to this combination. Another fluid-lens telescope, of the dialytic form, was constructed by Barlow, who made use of the high dispersive power of sulphuret of carbon, a beautifully transparent and colorless fluid. He was able to render achromatic a combination of a crown lens 8 in. in diameter with a fluid lens of half the size. There is however a practical objection to the use of sulphuret of carbon arising from the variability of its density by variations of temperature.—Reverting to what may be called the regular construction of achromatics, we find that the successors of Fraunhofer at Munich, and Guinand and Cauchoix at Paris, have produced object glasses of dimensions far superior to those of the Dorpat lens. Disks of 10, 12, and even more inches in diameter have become familiar to these master opticians, whose skill in working them keeps even pace with their manufacture; and in three Munich telescopes, two with more than 15 in. of clear aperture, one at Pulkova, another at the observatory of Harvard college, and the third at Greenwich (aperture 13 in.), have been in use for years. The two former have been the means of adding largely to the stores of astronomical knowledge; the Greenwich telescope has not been much used. —The few attempts made in the United States to manufacture optical flint glass have hitherto been but partially successful, and that with only small disks; but the American-wrought object glasses have earned for themselves a high place. Many have been made in New York by Henry Fitz, whose largest glass, 13 in. in diameter, was made for the Dudley observatory at Albany. Spencer, famous for the excellence of his microscopic objectives, made for Hamilton college a 13½-inch telescope, which is highly commended. But in exquisiteness of workmanship and performance, the object glasses made by Alvan Clark of Cambridge, Mass., have fairly distanced all competitors, native or foreign. Whoever will glance over the list of close double stars discovered with his 7- and 8-inch lenses (see "American Journal of Science," vols. xxv. and xxix.) will remark several stars that must have passed unnoticed under the review of Struve with his superior optical power. (See CLARK, ALVAN.) Mr. Dawes, one of the most skilful astronomical observers of his day, took in succession five or six large refractors from Clark (disposing of each in favor of a successor including some improvement of construction which had suggested itself), and these, scattered throughout England, attested the skill of the American optician in the special work of figuring object glasses, in which at present he and his sons are unrivalled. In 1859 Clark began the construction of a magnificent object glass of 18¾ in. clear aperture and with a focal distance of 23 ft., at that time the largest in the world. It was made from disks of Birmingham glass, which have a uniform density and freedom from veins, and, though only rudely mounted at first, quickly revealed the duplicity of the minute companion of $\alpha^2$ Capricorni. In January, 1862, it detected a companion to Sirius, perhaps the hitherto invisible one whose workings have been indirectly manifested in the variable movement of the larger star. This masterpiece, prevented from reaching its original destination, was secured for the Chicago observatory. In 1870 Clark was authorized by congress to begin the construction of a telescope 24 in. in aperture for the Washington observatory; but before the work was entered upon, the proposed aperture was changed to 26 in., Mr. Newall of Gateshead, England, having had a glass constructed for him by Cooke and sons, York, of the hitherto unequalled aperture of 25 in. The disks of glass, obtained by Clark from Chance and co. of Birmingham, reached Cambridge, Mass., in December, 1871, and the grinding was begun in January, 1872. "Owing to the great size of the glasses," says Prof. Newcomb, "the first rough grinding was done by machinery, the 'grindstone' being a rapidly revolving iron wheel, over which a stream of water and sand was kept running. The glasses were thus roughly brought to the desired shape in a few days. The forms chosen were much more simple than those usually employed in large glasses, the crown glass being double convex, with an equal curvature on each face; the flint nearly plane on one side, while the other was concave, with the same curvature as the crown glass. . . . In the month of June, 1872, the glass was in such good shape that only an expert could see any defect whatever. Looking through it we could read, at the distance of some 400 ft., a microscopic photograph illegible to the naked eye. . . . Artificial double stars, one third of a second apart, were clearly separated. In hands less severely critical than those of the

makers it would have passed as optically perfect. Nevertheless four months more were spent on it, and it was not till October that it was reported finished. . . . The influence of temperature on its figure was now quite perceptible. In the evening, while temperature was falling, the defect of the spherical aberration was one way, but after it became stationary the defect was slightly in the opposite direction." The telescope was mounted at Washington in 1874, and though as yet it has achieved no noteworthy discovery, the ease with which it has gone through the work which had been usually regarded as closely testing the powers of the largest telescopes shows what it is capable of.—In England, the attention of the mechanical astronomers, if we may so call them, has been of late years more especially occupied with the construction of large reflecting telescopes, and preëminent in this department was Lord Rosse, who about 1844 completed a telescope which has a clear aperture of 6 ft. and a focal length of 53 ft. This enormous instrument has two specula, one about $3\frac{1}{2}$ and the other about 4 tons in weight. At first each rested upon a system of 27 platforms most ingeniously arranged to distribute their support of this enormous weight in such a manner as to produce equal pressure in every position of the instrument. A strong pressure of the hand at the back of a speculum 4 tons in weight and nearly 6 in. thick produces flexure sufficient to distort the image of a star. At a later period 27 triangles, each with a ball at each angle, were substituted for the platforms, so that now the speculum rolls freely on 81 balls. The tube of the telescope is supported upon a massive universal joint of cast iron resting upon a pier of stonework, and it is so counterpoised by a chain suspension applied at the centre of gravity that it can be moved with great facility, a quick motion being given by a windlass below, and a controlling slow motion in either direction by the hand of the observer above. Various micrometers have been tried with this instrument, but the common filar micrometer with coarse threads answers best; and such is the quantity of light collected by the immense reflecting surface below, that the threads in the micrometer are always distinctly visible without artificial illumination even in the darkest night. The general processes of casting, grinding, and figuring these large specula are described in the article SPECULUM. Several other large reflectors have been constructed by Lassell, De la Rue, and Nasmyth; and the first of these transported to Malta a Newtonian telescope 4 ft. in diameter. De la Rue successfully applied his large telescopes to celestial photography, in which he has made many important improvements.—The manufacture of reflecting telescopes with glass specula received a new impulse from the discovery by Liebig of a process of coating glass with an infinitesimal film of pure metallic silver. From the first days of reflectors, as early as Newton, we find a proposition to substitute a silvered lens for the metallic mirror of his telescope, on account of the greater perfection with which glass could be wrought, and the greater durability of the polished surface. In 1740 Caleb Smith showed how, with glass mirrors silvered upon the posterior surface, the rays of different refrangibility, after twice passing through the glass, and thus becoming separated, might be united again by the action of a small concave lens placed not far from the focus of the mirror. The elder Herschel sometimes used glass reflectors for his smaller telescopes. In 1822 Airy proposed a combination of two silvered lenses in the Gregorian or Cassegrainian form, and showed how, by proper mutual adjustment of the two, a perfect achromatism might be obtained. In 1838, and again in 1841, Barfuss of Weimar found that, of the various forms of reflectors, the Cassegrainian was best adapted for glass mirrors. He demonstrated that in this form both chromatic and spherical aberration may be sensibly corrected in a telescope of 20 in. focus with full 5 in. aperture, and that such a telescope would bear even a power of 600. But by Liebig's discovery a still better field has been opened. His process consists in precipitating the silver upon the glass surface from an alkaline solution prepared by addition of caustic soda to the ammonio-nitrate. After immersing the glass for about three quarters of an hour, an extremely thin and regular film is obtained, which has a slight bronzy hue by reflected light, and will transmit a deep blue light when interposed between the sun and the eye. This film is said to be harder than ordinary silver, and, by friction with soft leather and perhaps a little dry rouge, is susceptible of receiving the most brilliant polish externally, while it answers perfectly in figure to that of the glass beneath. Foucault has also made use of a similar process (see SPECULUM), and succeeded in constructing telescopes of considerable dimensions. One was made by him of 13 in. aperture and only 88 in. focus, with which, under a magnifying power of 600, he could separate the components of the small companion of $\gamma$ Andromedæ. Steinheil, investigating the relative reflecting power of a speculum coated by this new process, as compared with others and with the transmitting power of some object glasses, found that, under an angle of reflection of 45°, the amount of brightness obtained was as follows:

| | |
|---|---|
| Direct light | 100 |
| Silvered mirror | 91 |
| Quicksilvered glass | 76 |
| Metallic mirror, one reflection | 67 |

Herschel gives also:

| | |
|---|---|
| Newtonian telescope | 44 |
| Gregorian or Cassegrainian | 40 |

Steinheil:

| | |
|---|---|
| Object glass by Fraunhofer transmits | 76 |
| Object glass by Steinheil | 87 |

We are now able to substitute for the heavy and intractable speculum metal a disk of glass which is far easier to cast and anneal, and being much firmer can be made of less than half the weight of the metallic mirrors.—The helioscope, for observing the sun, is a telescope with the aperture diminished as much as possible, and usually provided with shades of stained glass to protect the eye. Still, great inconvenience is felt from the intense heating power of the concentrated solar rays. Sir John Herschel proposed to use only the very small portion of light reflected from the first surface of glass, by constructing the large mirror of a Newtonian telescope of a double-concave, well polished lens, whose first surface only is truly figured to serve as reflector for the 2·6 per cent. of rays untransmitted and unabsorbed. The lower end of the telescope tube being left open, all the remainder of the light passes out and is dispersed. But even the small amount of reflected rays is still further reduced by the second reflection, which is made to take place at the first surface of a prism whose refracting angle should not be less than 30° or 40°, so that now the portion of light finally reaching the observer is but $\frac{1}{1300}$ of the direct illumination, in consequence of which immense reduction a very light shade only is needed. Porro of Paris, in constructing a telescope upon this principle, improved it by placing the prism for the second reflection at the polarizing angle for glass, whereby, upon introducing a Nicol's prism, the light may be enfeebled as much as desired without using any shade at all.—The great requisites of a telescope stand are firmness and stability, combined with a facility of motion which will allow the instrument to be pointed with ease and certainty to any part of the heavens. Fraunhofer, whose plan is now generally followed, adopted the equatorial form, as it is called, which consists essentially of a polar axis upon which the whole instrument is moved parallel with the celestial equator, and which carries in a socket another axis at right angles to itself, upon which latter the telescope moves from or toward the pole. By the combined motions command of the whole visible hemisphere is given, and with the advantage that, the instrument being once directed to a star, the observer can follow it in its diurnal path by motion upon the polar axis alone; moreover, by application of a simple train of wheelwork this motion can be effected by machinery, and the observer is thus enabled at his leisure to contemplate or to measure the objects which appear fixed as though in an immovable sky. In the immense English reflectors, the lower end of the tube rests upon the ground or some solid support, and even then for the needful motions of the instrument powerful appliances of machinery have been required; but in latter days mechanical engineers have been able so to combine and counterpoise great masses of cast-iron machinery as to effect with wonderful ease every delicate movement desired by the astronomer, and now the idea of mounting even these large telescopes equatorially is growing familiar. The application of clockwork movement to such large reflectors renders it practicable to use them for celestial photography, as well as for some extremely delicate astronomical measurements.—The application of the telescope to meridian instruments will be exemplified in the article TRANSIT CIRCLE; but the telescope is also universally used for differential measurements. For such observations various modifications or appliances have been from time to time suggested or practised. The filar micrometer is the most common auxiliary of the telescope, and in skilful hands is capable of astonishing accuracy. (See MICROMETER.) Great use has also been made of the power of producing and comparing together double images of the objects to be measured. These double images are produced in various ways. Savery in England in 1743, and Bouguer in France four years later, proposed, independently of each other, to measure the diameter of the sun by using two object glasses in the same telescope and with the same eye piece. In Savery's plan the glasses were all fixed so as to give two images of the sun whose outer edges were nearly in contact; and by measuring the variable distance of these edges, he obtained the corresponding variations of the semi-diameter from perigee to apogee. Bouguer made one of his object glasses movable, and thus could measure any angle from zero to his maximum limit, which was probably somewhat greater than the sun's diameter. In 1753 John Dollond invented the divided-object-glass micrometer, which has in later years, under the technical name of heliometer, achieved such wonders in the hands of Bessel and his followers. In this instrument the object glass itself when finished is divided into two equal segments, each of which forms its image independently of the other. When the semi-lenses are brought to their normal position of coincidence, the two images coincide also; but when separated, the images diverge, and the angle of divergence is measured by the amount of separation of the lenses. Thus the apparent diameter of a planet, for instance, is obtained by separating the images until their outer edges are in exact contact, and this may be more accurately perceived than the coincidence of the edge with a fine thread placed tangent to it as in the filar micrometer. Dollond proposed moreover to gain both accuracy and convenience of use by placing a divided object glass of very long focus before the speculum of a reflecting telescope, which would give a larger scale for the measurement of a given angle than would belong to a simple telescope of the same length. Fraunhofer was at the time of his death engaged in devising a heliometer which, when afterward completed, was placed at Königsberg. Bessel, whose "Theory of the Heliom-

eter" is one of the most elaborate and beautiful monographs of astronomy, was able with this instrument to grapple successfully with that even now most difficult practical problem, the measurement of the parallax of a fixed star. Several attempts have also been made, as by Rochon, Maskelyne, and Boscovich, to produce the double images by refraction through prisms or pairs of prisms, either beyond the object glass or sliding within the tube, as well as by dividing the small mirror of reflecting telescopes, as Ramsden suggested for the Cassegrainian form, and Brewster for the Newtonian. Divided-eye-lens micrometers have also been made, the best form of which is that given by Airy, who found the four-glass eye piece best adapted for this purpose, and divided the second lens, counting from the object glass. But in all the arrangements of divided lenses an essential imperfection arises from the exhibition of color and of some diffraction in the direction at right angles to that of the line of separation, and this practical inconvenience may be seriously felt in some classes of observations. On this account, it will probably yet be found most advantageous to make use of the double-refracting property of certain crystals for the separation of images.—This account would be imperfect without a sketch of the particular form of telescope employed by the American observing parties in photographing the recent transit of Venus. What was required was a large image of the sun at the focus of the object glass, or the principal focus as it is called. The size of this image is directly proportional to the focal length, and a focal length of about 40 ft. was required to give the image the desired dimensions. It would clearly have been impossible to provide telescopes of this length for distant stations, even if at Washington, Greenwich, or Paris instruments of such dimensions could be so driven by clockwork that the tube should remain constantly directed toward the sun. It became necessary, therefore, to make use of a heliostat, or plain mirror, so worked by a driving apparatus as to deflect the sun's rays constantly in the same horizontal direction. The construction of a plane mirror sufficiently true for this purpose was a task which fully taxed the skill even of Alvan Clark and his sons. "The slightest deviation from exactness," as Newcomb points out, "would be fatal; for instance, if a straight-edge laid upon the glass should touch at the edges, but be the 100,000th of an inch above it at the centre, the reflector would be useless." The mirrors were tested by observing objects through a telescope, first directly and then by reflection from the mirror. If they were seen with equally good definition in the two cases, it would show that there were no irregularities in the surface of the mirror; while if it were concave or convex, the focus of the telescope would seem shortened or lengthened. The first test was sustained perfectly, while the circles of convexity or concavity indicated by the changes of focus of the photographic telescope were many miles in diameter. During the total eclipse of April, 1875, the heliostat again came into play for photographic purposes, but unsuccessfully because of unwise arrangements. (See p. 905.)

**TELFAIR**, a S. county of Georgia, bounded S. and W. by the Ocmulgee and N. E. by the Little Ocmulgee river; area, 925 sq. m.; pop. in 1870, 3,245, of whom 1,145 were colored. The surface is level and the soil sandy, with extensive pine forests. The Macon and Brunswick railroad intersects the N. part. The chief productions in 1870 were 62,429 bushels of Indian corn, 15,823 of oats, 20,569 of sweet potatoes, 19,829 lbs. of wool, and 704 bales of cotton. There were 497 horses, 2,563 milch cows, 6,946 other cattle, 8,475 sheep, and 7,477 swine. Capital, Jacksonville.

**TELFORD, Thomas**, a British engineer, born at Westerkirk, Eskdale, Dumfriesshire, Aug. 9, 1757, died in Westminster, Sept. 2, 1834. While working in Edinburgh as a stone mason he studied architecture and drawing. In 1783 he removed to London, was employed on the quadrangle of Somerset house, afterward for three years as architect in the Portsmouth dockyard, then upon the alterations of Shrewsbury castle, and in the construction of numerous bridges, one of which over the Severn had a flat arch of 130 ft. span. He superintended the construction of the Ellesmere canal, 103 m. in length, and requiring extensive aqueducts, which he built of iron; the Caledonian ship canal, whose locks surpassed any previously built in size; and six other canals in England and Scotland, the Götha canal in Sweden, an immense tunnel at Harecastle on the Grand Trunk canal, besides 1,000 miles of new road and 1,200 bridges. The St. Katharine docks of London, the improvement of the Aberdeen and Dundee harbors, the construction of iron bridges with flat arches of 170 ft. span, and above all the Menai suspension bridge, were his work.—See "Life of Thomas Telford, Civil Engineer, written by Himself" (4to, with a folio volume of plates, 1838).

**TELIOSTS**, a name given by J. Müller to the common bony fishes from their well ossified skeleton; the term has been taken by Huxley for one of his orders. They comprise the ctenoids and cycloids of Agassiz.

**TELL, William**, a legendary hero of Switzerland. According to tradition, he was a hunter, living at Bürgelen in the canton of Uri. His wife was a daughter of Walter Fürst, who with Stauffacher of Schwytz and Melchthal of Unterwalden organized the conspiracy of the Grütli in 1307, and founded Swiss independence. Tell's part in the revolt against Austria is related as follows: Gessler, Austrian bailiff in Küssnacht, placed his cap upon a pole in the market place of Altorf, and gave orders that passers by should do it reverence. Tell neglected or refused to do this, and was arrested

and sentenced to death. But Gessler, hearing that he was a skilful marksman, told him his life would be spared on condition of his shooting an apple from his child's head. Tell ventured the shot, and succeeded without injuring the child. Gessler perceived that he had put a second arrow in his quiver just before shooting, and asked the object. Tell replied: "To kill you if I had harmed my son." For this he was again put in chains. Gessler then embarked for Küssnacht, taking Tell with him. On the way the boat was overtaken by a storm. The crew, fearing for their lives, begged Gessler to release Tell, that he might steer the boat. He complied, and as they neared the point now known as "Tell's Rock" or "Leap," Tell sprang ashore; but the most dangerous part of the coast had been passed, and the crew brought the boat safely to Brunnen. Meanwhile Tell went around by land, and, lying in ambush between Brunnen and Küssnacht, wounded Gessler mortally with an arrow. Gessler's death was the signal for a general uprising; the Austrian bailiffs were driven from the several cantons, and their castles destroyed. In 1315 Tell took part in the battle of Morgarten, and in 1354 was drowned in the Schächen while trying to save a boy's life.—Such is the story in its main features, as Schiller has embodied it in his drama. But recent historical investigations put it in a very different light. Schwytz, Uri, and Unterwalden struggled for autonomy against the Hapsburgs from 1240 to 1315, and later. The conflict seldom took the shape of armed hostilities; it was rather the gradual growth of local independence. We do not know the names of the leaders of the Swiss movement, but we do know that there was no conspiracy of the Grütli, that no such bailiffs as Gessler, Wolfenschiessen, and Landberg existed by those names, and no such men as Tell, Stauffacher, or Melchthal. A league was formed by Schwytz, Uri, and Unterwalden, but it was not a secret conspiracy, and it was formed in 1291 and not in 1307; and there was no uprising in 1308. Kopp (*Urkunden der Geschichte der eidgenössischen Bünde*, 1835), Huber (*Die Waldstädte bis zur Begründung ihrer Eidgenossenchaft*, 1861), W. Vischer (*Die Sage von der Befreiung der Waldstädte*, 1867), Rilliet (*Les origines de la confédération suisse*, 1869), and others, have shown how patriotic imagination in Switzerland, having lost the remembrance of the precise steps by which independence was obtained, has actually created the tradition in its present shape. The beginning was made by *Das weisse Buch*, a chronicle composed about 1470, in which first occur most of the names with which we are familiar. Then comes the *Tellenlied*, composed about the same time; then, in 1540, the *Hübsch Spyl* of Uri. But these and similar productions were all outdone by Ægidius Tschudi (1505–'72), in his *Chronicon Helveticum*. Tschudi seems to have gathered scraps of tradition wherever he could find them, to have expanded them and put them into the most plausible shape, and to have invented names, surnames, and even dates. Johannes von Müller and Schiller followed Tschudi. The popular version of the Swiss uprising, then, is to be regarded as a distortion of the facts, and its prominent persons and striking incidents are imaginative decorations added by generation after generation from the 15th to the 17th century. But Tell is the embodiment of a wide-spread Aryan myth. The Persian poet Ferid ed-Din Attar (about 1175) sings of a king who shoots an apple from the head of his favorite. Saxo Grammaticus, in his "Danish Chronicle" (about 1170), tells how Toko shoots an apple from the head of his son, by order of King Harold Bluetooth; here the incident with the second arrow is mentioned. In the Edda, Eigil the marksman is made by King Nidung to shoot an apple from the head of his son, and the incident with the second arrow again occurs. The name "Tell" has been variously explained. Grimm connects it with the Latin *telum*, an arrow; others with the German word *tall*, meaning half-witted. In *Das weisse Buch* Tell seeks to excuse his disrespect to the hat on the ground that he is dull of wit, saying, "Otherwise I should not be called the *tall*." According to Carrière, the Tell saga is neither history nor pure invention, but the reminiscence of ancient mythological poetry, recast and coupled with historical events. For a brief account of the Tell saga, see Carrière's edition of Schiller's *Tell* (Leipsic, 1871), and Buchheim's edition (London, 1871).

**TELL-TALE**, a bird. See TATTLER.

**TELLURIUM** (Lat. *tellus*, the earth), an elementary substance, discovered by Müller von Reichenstein in 1782, but first investigated and named by Klaproth in 1798; symbol, Te; chemical equivalent, 129; specific gravity, 6·65; hardness, 2 to 2·5. Though commonly classed among the metals, it has much analogy in its properties to sulphur and selenium. It fuses between 800° and 900° F., and can be distilled in a current of hydrogen. It is a bad conductor of heat and electricity. It occurs in a native state associated with iron pyrites and various metals, as gold, silver, bismuth, copper, or lead. The native metal is of a brilliant metallic lustre, of a tin-gray or lead-gray color, passing to steel-gray. It is very fusible before the blowpipe, and burns with a bluish flame, green on the edges; it volatilizes in white fumes, leaving no residue; and it is wholly soluble in nitric acid. The substance occurs in small masses, irregularly lamellar, and crystallized in six-sided prisms, at the mine of Maria Loretto near Zalatna in Transylvania. Its most common ore is the black, foliated mineral of Nagyág, which contains about 13 per cent. of tellurium in the form of tellurides of gold, lead, and silver, mixed with sulphides of antimony and lead. Tellurium is almost always combined with small portions of iron or gold

in a metallic state, silver, or lead, so that some have supposed that the substance ought to be considered as telluride of iron or of gold. Many natural alloys have been met with at the mines of Hungary and Transylvania, and from the collection of those presented by the emperor of Austria to the museum of natural history at Paris, Dufrénoy has arranged the varieties among the following five species: native tellurium, auro-argentiferous tellurium (graphic gold), auro-plumbiferous tellurium (müllerite), plumbo-auriferous tellurium (nagyagite), and telluric bismuth (tetradymite). Auro-argentiferous tellurium was recognized at the Gold Hill mines, North Carolina, and native tellurium at Red Cloud mine, Gold Hill, Boulder co., Colorado, by Dr. Genth; and telluric bismuth is found in many of the gold mines of Virginia and North Carolina, in foliated scales and lamellar masses. Gold and silver tellurides occur in masses on the Calaveras range in California. Tellurium forms two oxides, $TeO_2$, $TeO_3$, which correspond in composition to sulphurous and sulphuric anhydrides. Tellurous acid, $H_2TeO_3$, and telluric acid, $H_2TeO_4$, are analogous to sulphurous and sulphuric acids. With hydrogen it forms the gaseous compound $H_2Te$, analogous to sulphuretted hydrogen.

**TELLUS.** See TERRA.

**TEMES,** a S. E. county of Hungary, in the Trans-Tibiscan circle, watered by the Temes and Béga; area, 2,289 sq. m.; pop. in 1870, 356,174, mostly Roumans and Serbs, and about two thirds belonging to the orthodox Greek church. The soil is very fertile, but the climate is unhealthful. The chief products are wheat, maize, hemp, flax, fruit, wine, and cotton. Cattle, sheep, pigs, and bees are raised.

**TEMESVÁR,** a city of Hungary, capital of the county of Temes, on the Béga canal, connecting it with the Danube at Belgrade, 75 m. S. S. W., and 155 m. S. E. of Pesth; pop. in 1870, 32,754, chiefly Germans. It consists of the town proper, which is strongly fortified, and four suburbs, including the village of Mehala. It has been much improved by the draining of marshes. It has fine Catholic and Greek cathedrals, a magnificent synagogue, an arsenal, a theological seminary, a Catholic gymnasium, and a normal school. Leather, cloth, and other articles are manufactured.—The origin of the city is traced to the Romans. The Turks held it, despite a number of sieges, from 1552 to 1716, when it was rescued by the Austrians, under whom it became the capital of the Banat. In 1849 it was besieged for several months by the Hungarians, who were signally defeated here on Aug. 9 by Haynau. A monument was erected in commemoration of this siege, during which the city suffered severely.

**TEMISCAMINGUE, Lake.** See OTTAWA, vol. xii., p. 734.

**TÉMISCOUATA,** an E. county of Quebec, Canada, bounded N. W. by the St. Lawrence river and S. E. by New Brunswick; area, 1,771 sq. m.; pop. in 1871, 22,491, of whom 21,809 were of French origin or descent. It is watered by the Trois Pistoles and Madawaska rivers and other streams, and contains Lake Témiscouata, 30 m. long and from ½ m. to 1½ m. wide, the source of the Madawaska. It is traversed by the Grand Trunk and Intercolonial railways. Capital, Isle Verte.

**TEMPE,** a valley of Greece, in the northeast of Thessaly, between Mts. Olympus and Ossa, celebrated in antiquity for its beauty. Poets and rhetoricians often mentioned it as a type of sylvan loveliness, and it was also famed as a haunt of Apollo. It was with laurel from Tempe that the victors in the Pythian games were crowned. The most accurate description of the famous pass is that of Livy. The lofty cliffs rise almost perpendicularly on either side, and the Peneus rushes through the middle of the valley. The defile is about 5 m. in length, and is so narrow in parts as to afford space only for the river and the road. Right and left are the ruins of ancient fortresses, and numerous tumuli are seen.

**TEMPERAMENT,** a term used to express the differences in the physical and mental constitutions of individuals, referred from remote antiquity to peculiarities in the quality of the solids and fluids of the body. The ancients believed that the fluids of the body consisted of four humors (corresponding to the four then so-called elements, earth, air, fire, and water), which they named bile, blood, black bile (supposed to come from the spleen), and phlegm or watery fluid (believed to come from the brain); and, if either of these elements was in excess, that it gave rise in the above order to the bilious or choleric, sanguine, melancholic, and phlegmatic temperaments. This view was maintained by physicians to the time of Cullen, who admitted only two temperaments, the sanguine and the melancholic. The sanguine temperament is marked by a predominance of the circulatory system, with a strong and frequent pulse, firm flesh, plump figure, smooth and fair skin, ruddy complexion, soft and light hair, and light eyes; there is great nervous susceptibility, ready memory, lively imagination, cheerfulness, and a love for sensual pleasures; its diseases are generally violent and inflammatory. In Cullen's melancholic temperament the solids predominate, the figure being less plump and more firm, the hair and eyes black, the skin coarse and dark, the countenance sallow and sad; the disposition is gloomy and the temper suspicious; the manner is slow, grave, cautious, and impassive. Other temperaments as well characterized as the above are the bilious, lymphatic, and nervous. The bilious or choleric temperament is marked by a supposed predominance of the biliary system, with strong hard pulse, yellowish brown skin and dark hair, and moderately fleshy body; by violent and easily excited passions, firmness and inflexibility of

character, boldness, and perseverance. In the phlegmatic or lymphatic temperament the flesh is soft, the skin pale and flabby, hair light, pulse weak, and the figure rounded, with little expression of countenance or activity of mind and body. The prominent character of the nervous temperament is a great excitability of the nervous system, and the preponderance of the emotions and impulses over the reason and will; the muscles are small and soft, and the form generally slender.

**TEMPERANCE SOCIETIES.** See TOTAL ABSTINENCE.

**TEMPERED GLASS,** a peculiar condition of glass which has recently been produced by M. de la Bastie of France, by subjecting it while hot to the action of a bath of prepared oil, in which it is enclosed to prevent ignition. This treatment appears to confer a certain degree of toughness to the exterior, which enables it to bear much harder blows than common glass. When broken, however, it crumbles into dust or small fragments, like Prince Rupert's drops, and it cannot like ordinary glass be cut with a diamond into regular forms, but crumbles under the instrument. An attempt to grind it, or to cut it with the sand blast to any depth, produces disintegration. This indicates that the molecules are held together under a condition of strain, and an optical examination supports the same conclusion.

**TEMPLARS,** or **Knights of the Temple** (Lat. *milites templi*), the most celebrated and powerful of the mediæval military orders of Christendom. Its origin dates from 1117, when two French knights, Hugues des Païens and Geoffroi de Saint-Adémar or Saint-Omer, took on themselves the obligation of escorting the pilgrims who continually journeyed between Jerusalem and the river Jordan. They were soon joined by seven other knights, and were permitted by the patriarch of Jerusalem to add to the three usual monastic vows a fourth binding them to defend the holy sepulchre and to protect pilgrims travelling through Palestine. They were generously befriended and encouraged in the beginning by the knights hospitallers of St. John. They were very poor, being called "the poor soldiers of the holy city;" and the two founders in their first excursions rode on one horse, a fact perpetuated on the great seal of the order. Baldwin II., king of Jerusalem, gave them a lodging in his palace near the traditional site of the temple, and the canons of the adjoining church granted them a house for an armory. Their number was not allowed to increase beyond nine till the council of Troyes, 1127–'8, which Hugues des Païens and five of his brethren attended, and which commissioned St. Bernard of Clairvaux to draw up a rule for them, and devise a habit suitable to their mode of life. This rule, approved by Pope Honorius II. in 1128, is divided into 72 articles, several additions having been made. It bound the knights to be present at the public canonical office, and when absent on military service to recite certain vocal prayers at the stated hours; they were to abstain from flesh meat four days in the week, and to refrain from hunting and hawking; each knight was to have three horses and a squire. Their oath, on making their religious profession, bound them to defend at the peril of their lives the mysteries of the Christian faith, the seven sacraments, the 14 articles of belief, the Apostles' and Athanasian creeds, the Old and New Testaments with the interpretations of the fathers as approved by the church, the unity of the divine nature and the trinity of persons, and the virginity of the mother of Christ both before and after his birth; to perform military service beyond the seas whenever called upon to do so; and never to fly before three infidels, even when alone. The knights were given a white tunic and mantle to distinguish them from the hospitallers, the squires and servitors wearing black or the colors common to the country; and in 1146 they were permitted to wear a red cross on the left breast, the hospitallers wearing a white cross on their black mantles. Their banner was of white linen striped with black, and was thence called *beauséant*, the name given at the time to a horse marked with black and white, and *beauséant* became also the battle cry of the order; the red cross was added in 1166. Their helmet, in token of humility, had no crest, and their beards were uncut. The members were classed into knights, squires, servitors, and later chaplains, who were priests of noble birth. On assuming the habit of the order all were girt with a cincture of linen thread, as a badge of their service. The order was divided into provinces, the provinces into priories or bailiwicks, and these into preceptories, composed of a single house or several houses in close proximity. Over the whole order presided the master or grand master, having as his lieutenant the grand seneschal, both of whom, as well as the grand marshal, treasurer, &c., were elected by the knights in general chapter. The provinces were governed by provincial masters, grand priors, or grand preceptors; and the inferior officers were designated respectively as priors or bailiffs and preceptors. The head province and residence of the grand master was Jerusalem, and its chapter in ordinary times was invested with all the powers belonging to the whole order assembled in general chapter. Pope Alexander III. allowed the order to receive priests as chaplains, without binding them by a military vow. They were *ex officio* secretaries to the local chapters, and were often appointed preceptors, but were not eligible to the higher offices. The order came in course of time to be designated as sovereign, the grand master owing no allegiance to any prince, and being solely dependent on the pope in spirituals. Their houses were privileged, the ordinaries having no jurisdiction over them; their churches and cemeteries were not liable to in-

terdicts; their properties and revenues were exempted from tithes and taxation; and no person who had made profession as a templar could leave the order, unless he entered another of stricter observance. Many persons sought to be affiliated with the templars without being bound by vows, in order to share these manifold exemptions. There were also *oblati*, who in return for these privileges pledged themselves to maintain the rights of the order, and *donati*, or children given from infancy to be reared and incorporated therein.—The warm interest taken by St. Bernard in the soldiers of the temple, his enthusiastic advocacy of their cause, the solemn approbation given to it by the council of Troyes and Honorius II., and the heroic services already rendered by its first members to the Christians of Palestine, made them at once favorites with the princes and peoples of Christendom. The little band of nine soon grew into as many thousands. St. Bernard, whom the templars always designated as their "father," addressed them in 1146, at the prayer of Hugues des Païens, a series of exhortations, in which he defines their duties and the virtues peculiar to their profession. But while detailing their recent services and their extraordinary increase, he mentions a circumstance pointing to an early cause of degeneracy: "that the greater number of the nobles who have joined the soldiers of the temple had been men stained by every species of crime, whose conversion, while ridding Europe of oppressors and scourges, gave defenders to Palestine." In the East, besides the province of Jerusalem, the order possessed those of Tripoli and Antioch; in the West were the provinces of France, Auvergne, Normandy, Aquitaine, Poitou, Provence, England (including Ireland and Scotland), Germany, Upper and Central Italy, Apulia, Sicily, Portugal, Castile, Leon, and Aragon. The French provinces were by far the most important, and gave to the order the great majority of its members, as well as its wealthiest possessions. So rapidly had these accumulated throughout Christendom, that Matthew Paris affirms that in the middle of the 13th century they held 9,000 manors. They became more interested in extending and guarding their possessions than in affording protection to pilgrims; and notwithstanding their unquestioned prowess and daring, their frequent feuds with the rival order of the hospitallers, and their open licentiousness and lust of gain, often injured the cause to which they had devoted themselves. They aided or thwarted the plans of campaigns at their pleasure, and frequently stained their knightly name and fame by open treachery, as in the sixth crusade under the emperor Frederick II., the partial failure of which was attributed to the machinations of the templars. During the gradual decline of the Christian kingdom in Palestine they endeavored by separate treaties with the Saracens to secure their own possessions in that country. After having their chief seat successively in Jerusalem (1118–'87), Antioch (1187–'91), Acre (1191–1217), and the Pilgrim's Castle near Cæsarea (1217–'91), they were nevertheless compelled at the final extinction of the Latin power in Palestine in 1291 to remove to the island of Cyprus, which they had purchased from Richard I. of England for 35,000 silver marks. Though driven out of the Holy Land, the organization evinced no signs of decay, and its extensive ramification throughout Europe drew upon it the suspicion and jealousy of princes, whose cupidity was also excited by its immense wealth. Under the influence of these motives, and irritated by his inability to tax the order, Philip the Fair of France determined upon its destruction, and induced Pope Clement V. to have a judicial inquiry instituted into the orthodoxy and morality of the order. Accordingly, in 1306 Jacques de Molay, the grand master of the templars, was enticed to Paris, and on Oct. 13, 1307, all the members of the order in France, including De Molay himself, were taken into custody, and their houses and goods were everywhere seized. The formal charges imputed to them grave heresies and idolatry connected with their secret rites of initiation and internal discipline, and graver violations of morality; but there was no evidence of these beyond their own confessions, wrung from them by torture. The pope hesitated to promulgate the decree for the extinction of the order; but Philip procured one of his creatures, the archbishop of Sens, whose jurisdiction extended over Paris, to convoke his provincial council in that city on May 10, 1310; and on the 13th of the month, by command of that body, 54 members of the order were burned at the stake in a field behind the abbey of St. Antoine. The example was imitated elsewhere, and on May 2, 1312, Clement on his own responsibility, the general council of Vienne then in session being averse to precipitate measures, issued a bull for the abolition of the templars. In it he expressly declares that he does not pronounce "a definitive judgment" on the guilt of the templars, the charges against them not being proven; but that to prevent the further growth of a monstrous scandal, and for the greater good of Christendom, he suppresses the order, reserving to the holy see a final judgment as well as the disposition of the persons and property of the members. Their movable property was for the most part appropriated by the sovereigns of the countries in which it was deposited; and although their landed possessions were nominally transferred to the hospitallers, the crown as a general thing secured the disposition of them. The order ceased at once throughout Christendom except in Portugal, where it assumed the name of the knights of Christ, which order still subsists. Finally De Molay, Guy of Auvergne, and other high dignitaries of the order were burned at the stake, March 18, 1314.

**TEMPLE, Frederick**, an English bishop, born Nov. 30, 1821. He graduated at Oxford in 1842, and was elected fellow and mathematical tutor of his college. In 1846 he took orders, in 1848 was appointed principal of the training college at Kneller Hall, near Twickenham, in 1855–'7 was an inspector of schools, and in 1858 was appointed head master of Rugby school and chaplain in ordinary to the queen. In 1860 he contributed the first of the essays ("On the Education of the World") in the volume known as "Essays and Reviews." In 1868 he supported Mr. Gladstone's measures for the disestablishment of the Irish church, and was nominated bishop of Exeter, and consecrated on Dec. 21, 1869. He has published "Sermons preached at Rugby School, 1858–'69" (3 vols., 1861–'71).

**TEMPLE, Richard Grenville**, earl, an English statesman, born Sept. 26, 1711, died at Stowe, Buckinghamshire, Sept. 11, 1777. He was the eldest son of Richard Grenville and Hester Temple, and in 1752 succeeded his mother, who had been created in 1749 Countess Temple, as Earl Temple. The marriage of his sister Hester Grenville with William Pitt, afterward earl of Chatham, was the means of introducing him to public life, and during the first Pitt administration he was a prominent member of the cabinet. In 1852–'3 appeared "The Grenville Papers" (4 vols. 8vo), comprising the correspondence of Earl Temple and his brother George Grenville between 1742 and 1777, edited by W. J. Smith. The present representative of the Grenvilles is the duke of Buckingham and Chandos.

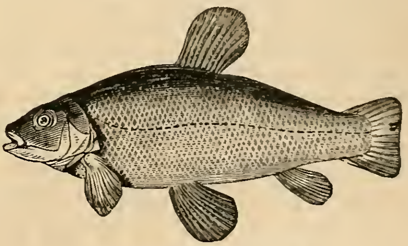
**TEMPLE, Sir William**, an English statesman, born in London in 1628, died at Moor Park, Surrey, Jan. 27, 1699. He was the son of Sir John Temple, master of the rolls in Ireland. After passing two years at Emmanuel college, Cambridge, he went abroad without taking a degree, and made the continental tour. He was married in 1654, and for several years resided with his father in Ireland. He represented the county of Carlow in the Irish convention in 1660, and also in the first Irish parliament after the restoration. In 1663 he removed to England, and in 1665 was sent on a secret mission to the bishop of Münster. In reward for his services, he was created a baronet and appointed resident at Brussels. In 1667 he visited Holland, and urged upon his government the necessity of a league with that country against the projects of Louis XIV. Receiving, in January, 1668, the necessary powers to negotiate such a treaty, he concluded the triple alliance between England, Holland, and Sweden, by which the contracting parties bound themselves to endeavor to bring about a peace between France and Spain, and to keep the former power out of the Low Countries. After perfecting at Aix-la-Chapelle negotiations for peace in pursuance of this alliance, he went in August, 1668, as ambassador to the Hague. Recalled to England in September, 1670, he discovered that the ministry had formed a secret treaty with France, by which the triple alliance was rendered of no effect, and in June, 1671, received his dismissal. For two or three years he resided at his estate of Sheen; but in 1674 he was summoned to negotiate a peace with Holland, which he accomplished in London. He returned soon afterward to his former post at the Hague, and was also one of the mediators deputed to attend the congress of Nimeguen, which resulted (1678) in an unsatisfactory treaty of peace between France and Holland, which Temple refused to sign. Returning to England, he declined to accept the office of secretary of state; but Charles II., harassed by the violence of parliament, gladly availed himself of Temple's advice, and his plan for a new privy council of 30 members, 15 to be great officers of state and 15 independent noblemen and gentlemen of great weight and landed possessions, was carried into effect in April, 1679. But in consequence of several perversions of its fundamental principles, and the admission of Lord Shaftesbury as a member contrary to his advice, Temple ceased to attend the regular meetings. A single session of parliament, to which he had been elected from the university of Cambridge, satisfied him with legislative life; and his name being stricken from the list of privy councillors in 1680, he thenceforth lived in retirement, either at Sheen or at Moor Park, a seat in Surrey. During the last ten years of his life Jonathan Swift was his secretary. His works comprise "Observations upon the United Provinces of the Netherlands," essays on the "Origin and Nature of Government," "Ancient and Modern Learning," "Gardening," &c., and a variety of political and miscellaneous tracts. His collected works were first published in 1720, edited by Swift; the last and best edition is in 4 vols. 8vo (London, 1814).

**TENANT.** See Lease, and Tenure.

**TENASSERIM**, a commissionership of British Burmah, on the E. side of the bay of Bengal, extending 650 m. from N. to S., with a breadth of from 30 to 80 m., between lat. 10° and 19° 30′ N., and lon. 95° 30′ and 99° 30′ E., bounded N. by Burmah, E. by Siam, S. by the Malay peninsula, and W. by the bay of Bengal, gulf of Martaban, and the administrative division of Pegu, from which last it is partly separated by the river Salwen; area, 46,730 sq. m.; pop. in 1872, 576,765. The country is divided into the districts of Amherst, Tavoy, Mergui, Shwegyen, Salwen, and Toungoo (which till recently was a division of Pegu); and the chief towns are Amherst, the capital, Maulmain, Martaban, Tavoy, Mergui, and Tenasserim. The sea coast of Tenasserim is about 500 m. in length. S. of lat. 11° 40′ it is bold and rocky, while further N. it is flat and much indented with bays, creeks, and estuaries. Along its whole extent are situated islands which appear from seaward to form part of the shore. Those lying S. of lat. 14° 40′ N. are known collec-

tively under the name of the Mergui archipelago. They vary greatly in form and dimensions, and are mainly situated from 30 to 80 m. off the shore. The most important island on the coast, however, is Balugyun, opposite the town of Maulmain, 17 m. long and 8 m. broad. The territory of Tenasserim is generally hilly or mountainous. It is intersected by numerous rivers, particularly toward the north, the principal being the Salwen, Attaran, Tavoy, and Tenasserim. The area of the basins of the rivers is estimated at about 14,000 sq. m. The E. boundary is formed by a range of wooded mountains varying in height from 3,000 to 4,000 ft. above the sea. In the north there is a separate range, about 2,000 ft. high, covered with bamboo jungles. There are extensive plains and fertile valleys lying upon the banks of the northern rivers. The staple productions are rice, cotton, sugar cane, indigo, and tobacco; and wheat, nutmegs, spices, and dye stuffs are raised. The country is exceedingly rich in valuable forest trees, prominent among which is the teak. Nearly 380 different varieties of timber have been enumerated. The timber forests are under strict and careful governmental control. Tin is mined, and iron, gold, and antimony are also found. Coal of good quality has been discovered in several places. The climate is considered remarkably healthful, the rate of mortality among Europeans being little more than it is in Europe under like circumstances. The thermometer rarely rises above 90°, the average being 77°. The rainy season begins in the S. part of the territory about the 1st of May, and at Maulmain a month later; the rainfall is much greater toward the north, where it is estimated at 200 in. a year. The average for the whole country is not less than 100 in.—The population comprises Burmese, Peguans, Siamese, Karens, Seelongs, Hindoos from the Coromandel coast, half-caste Portuguese, Chinese, a few American missionaries, and the English officials and traders. The Burmese and Peguans are the most numerous; the Siamese are principally settled in the neighborhood of the Tenasserim river. The chief manufactures are cotton and silk goods, coarse pottery, and iron cooking vessels. Ship building is largely carried on at Maulmain, and to a less extent at Mergui and Tavoy. These three places are the principal ports of Tenasserim, in regular steamship communication with each other and the Indian peninsula. The chief exports consist of rice, tobacco, gambir, ivory, edible birds' nests, and teak timber.—The Portuguese visited the territory which forms the Tenasserim division early in the 17th century; and in 1687 some English were massacred at Mergui, the country being then a dependency of Pegu. It afterward became subject to Siam, from which power it was taken about the middle of the 18th century by the Burmese, who held it till it was annexed to British India at the termination of the Burmese war in 1826. From the long unsettled state of the country, the entire population at that time amounted only to about 30,000; and its subsequent rapid increase is attributable to the security for life and property afforded by British rule. The town of Tenasserim, on the river of the same name, in lat. 12° 2′ N., lon. 98° 55′ E., was formerly the capital, but is now largely in ruins.

**TENCH,** a soft-rayed, fresh-water fish of the carp family, and genus *tinca* (Cuv.), peculiar to the old world. The best known species is the *T. vulgaris* (Cuv.), rarely more than 14 in. long, of a deep yellowish brown, and sometimes golden and greenish; the dorsal and anal fins have no osseous rays, and the former is inserted behind the commencement of the ventrals; the teeth on the pharynx are compressed and club-shaped; scales very minute, covered with mucus; a very small labial barbel at each side of mouth; the body thick and broad, and the ventrals in the male much larger than in the female. It is spread over Europe and N. Asia, and is more or less abundant in the ornamental waters and ponds of Great Britain, but is not found much above lat. 60° N.; it prefers stagnant waters with a muddy bottom, concealing itself in winter in the mud in a torpid state; like the carp it is very tenacious of life; the food consists of worms and aquatic insects, with sometimes seeds and plants. The eggs are deposited in May or June; they are very minute, greenish, about 300,000 in a single female, and are placed among aquatic plants. In its natural state the flesh is not good, but is delicate when the fish are properly fed.



Common Tench (Tinca vulgaris).

**TENCIN, Claudine Alexandrine Guérin de,** a French woman of society, born in Grenoble in 1681, died in Paris, Dec. 4, 1749. She became a nun, and like her two sisters led a gay life at her convent, and after her transfer as canoness to a less strict monastery near Lyons she was accused of being *enceinte*. In 1714 she was absolved from her religious vows, and went to Paris to live in the home of her brother, the future cardinal and statesman, for whom she displayed a passionate devotion, which subjected her to odious insinuations. She worked steadily for his advancement, acquired a fortune through the financier Law, and was for short periods mistress of Cardinal Dubois and of the regent duke of Orleans. By the poet Destouches she became (Nov. 16, 1717) mother

of D'Alembert. (See ALEMBERT.) In 1726 she was arrested on a charge preferred against her in the will of La Fresnay, one of her many lovers, who had killed himself in her house, of having sought to destroy him; but the charge fell to the ground. After her speedy release she showed greater discretion, and confined herself more exclusively to her associations with Fontenelle, Montesquieu, and other scholars who attended her receptions, which were among the first of the kind in France. She published *Les mémoires du comte de Comminges* (1735); *Le siége de Calais*, a historical novel (2 vols., 1739–'40); and *Les malheurs de l'amour* (1747). Her correspondence with her brother, the cardinal, was published in 1790, and *Lettres au duc de Richelieu* in 1806. Her works have frequently been published together with those of Mme. de Lafayette. One of the best editions is by Jay and Étienne (5 vols., Paris, 1825).—See *Mémoires secrets de Mme. de Tencin*, by the abbé Barthélemy (Grenoble, 1790).

**TENDER,** in law, an offer to perform an act, for the performance whereof one person is bound to another. The obligation, and so the offer, may be to pay money or to deliver specific articles. If the tender be of money, it is effectual only when the demand is one of money, and is definite in amount, or is capable of being made so. Thus, a tender cannot be pleaded as a defence to an action upon a contract, unless the contract be one for the payment of money, as for rent; nor to an action for a tort, as for assault and battery. In short, wherever the claim is for unliquidated damages, the general rule is that no tender is admissible. In some of the United States, however, cases of involuntary trespass form an exception, founded partly on usage and partly on express statutory provisions. A tender may be by the defendant in person, or by a third person at his request; and it should be made to the creditor personally, or to some one authorized by him to receive the money. At common law, a tender must be made on the very day the money is due, if that day be made certain by the contract. But the statutes and usages of the states generally permit the tender to be made after that day, if before the action is brought; and in some it may be made after the action is brought. Tender is generally not good if made before the debt is due, but may in some cases be so if it includes interest up to the day of maturity.—A tender of money is not complete without production and offer of the money, unless the creditor expressly or impliedly waives the production. Thus it is said not to be enough in a plea of tender, if the plaintiff did not object to receive the money, for the defendant to prove that he had the money in his pocket, and said to the creditor that he had it ready for him, and asked him to take it. He ought to have produced and offered the money specifically. What amounts to a waiver on the part of the creditor is a nice if not difficult question. It seems from the cases that the creditor may not only waive the actual production of the money, but the actual possession of it in hand by the debtor. The debtor is not bound to count out the money if he has it and offers it.—The tender must be made without any condition that the creditor may with good reason object to. A demand of a receipt in full of all demands has often been held to invalidate a tender; not so much because a receipt was asked for, as because part was offered in full payment. And it seems that a debtor would lose the benefit of a tender if he should accompany it with a demand of a receipt for the sum that he pays, and because it was refused should retain the money. Tender of a larger sum than is due, with a request of the change or the balance, is not good; but a refusal of the money offered, for reasons distinct from the manner in which the offer is made, as for the insufficiency of the sum or the like, is a waiver of all objection to the form of the tender. The tender should be made in money made lawful by statute. A tender of good and current bank notes is good if no objection is made on the ground that they are not money. The effect of a tender will be destroyed if the creditor can show a subsequent demand by him of the proper fulfilment of the contract at the proper time, and a refusal by the debtor.—Tender does not bar a debt as payment would, but rather establishes the liability of the defendant; for, in general, he is liable to pay the sum which he tenders whenever he is required to do so. But the tender stops the recovery of damages or interest for delay in payment, and gives the defendant subsequent costs, provided the plaintiff recovers nothing beyond the sum tendered.—As in sales the property in chattels does not pass while any necessary act remains to be done, so if there be an obligation to deliver those articles, it may be said as a general rule that the obligation is not discharged by tender so long as anything is left undone which would prevent the property from passing under a sale. Chattels tendered, therefore, should be separated and distinguished from any others, and not be so mingled with others that are not to be delivered that they cannot be separately identified. The tender of goods may be made to an agent or by an agent, and must be equally unconditional as if of money; and if the agent of the deliverer has orders to deliver the chattels to the receiver only if he will cancel and deliver up the contract, this is not a tender, although the agent had the chattels at the proper time and place. Generally, if no time or place be specified, chattels are to be delivered where they were at the time of the contract, unless collateral circumstances designate a different place. If the time be fixed, but not the place, it will be presumed that the deliverer was to bring the articles to the receiver at that time; and for that purpose he must go with the chattels to the residence or place of business of the receiver, unless

something in their very nature or use, or some other circumstance of equivalent force, distinctly implies that they are to be left at some other place. And it may happen from the cumbrousness of the articles, or other circumstances, that it is obviously reasonable and just for the deliverer to ascertain from the receiver, long enough beforehand, where they shall be delivered; and then he will be held to this as a legal obligation. If the receiver refuses or neglects to appoint a place, or purposely avoids receiving notice of a place, the deliverer may appoint any place with a reasonable regard to the convenience of the other party, and there deliver the articles. If no expressions used by the parties and nothing in the nature of the goods or the circumstances of the case control the presumption, then the place where the promise is made is the place where it should be performed; and no action can be maintained upon such a promise unless the plaintiff can show a demand at the proper place and time, or a readiness to receive, and notice equivalent to a demand, or else that the demand would have been nugatory because the defendant could not have complied with it. If by the terms of the contract specific articles are to be delivered at a certain time and place in payment of an existing debt, this contract is fully discharged and the debt is paid by a complete and legal tender of the articles at the time and place, although the promisee was not there to receive them; and no action can be thereafter maintained on the contract. But the property in the goods has passed to the creditor, and he may retain them as his own, or take them elsewhere; or he may demand them, and if they are refused bring an action for them as his own.

**TENDON**, the fibrous cord or expansion by which a muscle is connected with the surface of bone. Tendons are composed of parallel bundles of white, inelastic, inextensible, fibrous tissue, the spaces between which are occupied by thin layers of loose areolar tissue, with a small proportion of elastic fibres, sufficient to allow a slight gliding motion of the different tendinous bundles upon each other. As a whole, however, the tendon is both inextensible and inelastic, and thus conveys at once the movement imparted by the muscular contraction to the bone into which it is inserted. The typical form of a tendon is that of a long, flexible, cylindrical cord, like those at the lower part of the forearm, for the flexion of the wrist and fingers. Others are more or less spread out into a ribbon-like form, like that of the sterno-mastoid muscle at the upper extremity of the sternum; while others are expanded into a broad and thin sheet or aponeurosis, like the tendinous expansions of the *latissimus dorsi*, or of the muscles on the anterior part of the abdomen. The long and cord-like tendons often run in narrow grooves of bone, in which they are confined by fibrous sheets passing over them from edge to edge. Their movement is sometimes facilitated by the existence of closed sacs or *bursæ*, situated between them and the bony surfaces over which they pass, and filled with a glairy lubricating fluid. Sometimes, as in the case of the tendon of the superior oblique muscle of the eyeball, they pass through a pulley-like loop or fibrous ring, and then return in an oblique direction to be inserted somewhere between the loop and their point of origin. Sometimes they have developed within them at certain points, where crossing articulations, small bones termed "sesamoid bones," the inner surface of which takes part in the formation of the joint. The patella, or knee pan, is regarded as an unusually large sesamoid bone, developed in the tendon of the great extensor muscle on the front part of the thigh.—Owing to their strong fibrous texture and inextensible quality, the tendons, when contracted or bound down by unnatural adhesions, are liable to produce or perpetuate deformities, particularly in the neck and the extremities. They require, under these circumstances, to be divided by a subcutaneous incision, releasing the contracted parts without bringing the air into contact with the wounded surface. This practice, known as "tenotomy," is largely resorted to in cases of wry neck, club foot, and many similar deformities.

**TENEDOS** (in earliest antiquity *Calydna*, *Leucophrys*, *Phœnice*, and *Lyrnessus*), a small island, about 10 m. in circumference, in the Grecian archipelago, now belonging to Turkey, 13 m. from the mouth of the Hellespont, and 4 m. W. of the coast of the Troad; pop. about 7,000, two thirds Greeks. The interior is fertile and well cultivated, producing corn, cotton, fruits, and excellent wine. The small town of Tenedos, on the E. coast, has a good port and is defended by two forts; the Greek quarter was almost entirely destroyed by fire in July, 1874.—In the legend of the Trojan war the island is mentioned as the place to which the Greeks withdrew their fleet, in order to make the Trojans think that they had departed, after leaving the wooden horse before Troy; and it was employed in the Persian war by Xerxes as a naval station. Subsequently, on several occasions, as in the Peloponnesian, Macedonian, and Mithridatic wars, it figured conspicuously as a stronghold; and in the middle ages the Turks and Venetians long contested its possession.

**TENERANI, Pietro**, an Italian sculptor, born at Torano, near Carrara, Nov. 11, 1789, died in Rome, Dec. 14, 1869. He studied after 1814 in Rome under Canova and Thorwaldsen, and became professor and finally president of the academy of St. Luke, and in 1860 chief director of museums. He excelled in religious and classical works, some of which are regarded as superior to the later productions of Canova, and became the head of a school distinguished for a careful elaboration of details and for graceful execution. His best known works include "Christ on the Cross," in silver, in St. Stephen's at Pisa; "The Descent from the

Cross," in the Torlonia chapel of St. John Lateran; the "Angel of the Last Judgment," in St. Mary's, Rome; "Flora," in possession of Queen Victoria; portrait busts of Thorwaldsen and Pius IX.; and many statues, including one of Bolivar. His last important work is the sarcophagus of Pius VIII. for St. Peter's.

**TENERIFFE** (Sp. *Tenerife*), one of the largest islands of the Canary group, about 150 m. N. W. of Cape Bojador, Africa. It is of triangular form, the N. and S. E. sides about 60 m. long, and the W. side 24 m.; area, about 800 sq. m.; pop. about 95,000. The coasts are steep, high, and broken by deep fissures; there are very few sand beaches, and no port accessible to large vessels which is secure in all weathers; but Santa Cruz, the capital of the island and of the Canaries (pop. about 11,000), has a good harbor. The island is volcanic. A lofty ridge traverses it centrally, and culminates near the W. side in the celebrated peak of Teneriffe or Teyde, 12,182 ft. above the sea. This consists of an enormous dome of trachyte covered with layers of basalt, rising from a plateau 7,500 ft. high. The peak itself rises about 2,350 ft. above the last narrow plain; its sides are very steep and difficult of ascent, and the summit is a narrow wall enclosing a crater about a mile in diameter with an average depth of 106 ft. The eruptions from this crater ceased long before the island was discovered by Europeans; but there have been recent eruptions from other craters, notably in 1704, '5, and '6, and 1798, the most recent. Hot vapors arise from the craters, and their surfaces are always warm. The next highest elevations are Chahora, 9,885 ft., 2½ m. S. W., and Azulejos, 9,400 ft., 3½ m. S. of Teyde. About one seventh of the island is fit for cultivation; the most fertile districts are at the E. end, the best being the plain of Laguna, about 12 sq. m. in extent, from which large crops of grain are obtained. The principal productions are cochineal, nuts, wine, and fruit; the first named is the only one of importance in commerce. In 1873 there was exported 2,476,433 lbs. of cochineal, valued at $1,225,289 in gold. The total value of all other exports during the same year was $295,060; of all imports, $1,988,045, including 3,390 tons of coal. The value of exports to the United States for the year ending Sept. 30, 1874, was $30,000. The commerce of the island is nearly all conducted through Santa Cruz. The only other important town is Laguna, in the plain of that name, with a fixed population of about 10,000, largely increased in the hot season. Orotava, on the N. coast, gives its name to a beautiful valley, formerly famous for its gigantic dragon tree, which was blown down by a hurricane at the beginning of 1868.

**TENIERS. I. David,** called the elder, a Flemish painter, born in Antwerp in 1582, died there in 1649. He was educated in the school of Rubens, subsequently studied in Italy, and after his return to Antwerp devoted himself exclusively to cabinet pictures. His favorite subjects were rural sports and merrymakings, alehouse interiors, chemists' laboratories, and grotesque subjects, such as the temptation of St. Anthony. He was greatly distinguished as a colorist, and his pictures commanded during his lifetime large prices. **II. David,** the younger, born in Antwerp in 1610, died in Brussels, Feb. 11, 1685. He early displayed a genius far superior to that of his father in the same specialty of painting, and found a patron in the Austrian archduke Leopold at Brussels, governor of the Spanish Netherlands, who appointed him gentleman of his bedchamber and his principal painter. The king of Spain appropriated a special gallery to his works, and he had hardly time to meet the fast increasing demand for them. He became director of the academy of Antwerp in 1644, but spent most of his life in the country near Mechlin, in order to familiarize himself with the life of the peasantry. His extraordinary facility in imitating the paintings in the archduke's gallery caused him to be called the Proteus of his art, and he was not less remarkable for his rapid, faithful, and elaborate execution. His charming delineations of the haunts and amusements of the toiling classes made him the most popular of all Flemish painters. He produced more than 1,000 pictures, including some of stupendous size. Among those best known are "The Village Wedding," "The Prodigal Son," "Heron Shooting," "The Bagpipe Player," and others in the Louvre, and "A Music Party," "Boors Regaling," "The Misers," and "Players at Trictrac," in the national gallery of London.

**TENNANT, William,** a Scottish poet, born at Easter Anstruther, Fifeshire, in 1785, died near Dollar, Feb. 15, 1848. He was educated at the university of St. Andrews. At an early age he lost the use of his feet, and in 1801 became clerk to his brother, a corn factor of Glasgow. Returning to Anstruther, he published in 1812 "Anster Fair," in the *ottava rima*, which passed through many editions. In 1813 he became parish schoolmaster of Dunino, and there mastered the Arabic, Syriac, and Persian languages. He afterward taught at Lasswade and at Dollar academy, and in 1835 was made professor of oriental languages in St. Mary's college, St. Andrews, and compiled Syriac and Chaldaic grammars. He published "The Thane of Fife" (1822); "Cardinal Beaton," a tragedy (1823); "John Balliol," a drama (1825); "The Dinging Down of the Cathedral" (of St. Andrews); "Hebrew Dramas founded on Bible History" (1845); and a "Life of Allan Ramsay" (New York, 1852).

**TENNEMANN, Wilhelm Gottlieb,** a German historian of philosophy, born at Brembach, near Erfurt, Dec. 7, 1761, died in Marburg, Sept. 30, 1819. Abandoning theology for philosophy, he completed his studies at Jena, and was professor there from 1798 to 1804, and subsequently at Marburg. After opposing the

Kantian system he became one of its first adherents. His most important work is the *Geschichte der Philosophie* (11 vols., Leipsic, 1798–1819), in which all systems are regarded from the standpoint of the critical school. An abridgment, *Grundriss der Geschichte der Philosophie* (Leipsic, 1812; 5th ed., 1828), has been translated into English by Arthur Johnson (Oxford, 1832; revised by J. D. Morell, London, 1852). His other works include *System der Platonischen Philosophie* (4 vols., Leipsic, 1792–'4), and translations into German from Locke, Hume, and De Gérando.

**TENNENT,** Sir **James Emerson,** a British author, born in Belfast, April 7, 1804, died in London, March 6, 1869. His name was originally Emerson, Tennent being added on the succession of his wife to the estate of her father, William Tennent. He graduated at Trinity college, Dublin, and was called to the bar at Lincoln's Inn in 1831, but never practised. Under the name of Emerson he published "Travels in Greece" (1825); "Letters from the Ægean" (2 vols., 1829); and "History of Modern Greece" (2 vols., 1830–'45). In 1832 he was elected to parliament for Belfast, and represented that city most of the time till 1845. From 1841 to 1845 he was secretary to the India board; in 1845 he was appointed civil secretary to the colonial government of Ceylon, and knighted. He returned in 1850, and in 1852 was member of parliament for Lisburn, and for a few months of that year secretary of the poor-law board. In November, 1852, he became one of the joint secretaries of the board of trade, and on his retirement in February, 1867, he was created a baronet. His works include "Belgium" (2 vols., 1841); "A Treatise on the Copyright of Designs for Printed Fabrics, &c." (1841); "Christianity in Ceylon, with an Historical Sketch of the Brahminical and Buddhist Superstitions" (1850); "Wine, its Use and Taxation" (1855); "Account of Ceylon" (2 vols., (1859; 5th ed., enlarged, 1860); "Sketches of the Natural History of Ceylon" (1861); "The Story of the Guns" (1864); and "The Wild Elephant, and the Mode of capturing and taming him in Ceylon" (1867).

**TENNESSEE,** one of the southern states of the American Union, the third admitted under the federal constitution, situated between lat. 35° and 36° 35′ N., and lon. 81° 37′ and 90° 15′ W.; greatest length from E. to W. 432 m., breadth 109 m.; area, 45,600 sq. m. according to the federal census, or 42,000 as reported by the state authorities. Its shape is rhomboidal, its E. and W. sides sloping at considerable, though not equal angles. It is bounded N. by Kentucky and Virginia, S. E. by North Carolina, S. by Georgia, Alabama, and Mississippi, and W. by Arkansas and Missouri, from which it is separated by the Mississippi river. The state is divided into 94 counties, viz.: Anderson, Bedford, Benton, Bledsoe, Blount, Bradley, Campbell, Cannon, Carroll, Carter, Cheatham, Claiborne, Clay, Cocke, Coffee, Crockett, Cumberland, Davidson, Decatur, De Kalb, Dickson, Dyer, Fayette, Fentress, Franklin, Gibson, Giles, Grainger, Greene, Grundy, Hamblen, Hamilton, Hancock, Hardin, Hawkins, Hardeman, Haywood, Henderson, Henry, Hickman, Houston, Humphreys, Jackson, James, Jefferson, Johnson, Knox, Lake, Lauderdale, Lawrence, Lewis, Lincoln, Loudon, McMinn, McNairy, Macon, Madison, Marion, Marshall, Maury, Meigs, Monroe, Montgomery, Moore, Morgan, Obion, Overton, Perry, Polk, Putnam, Rhea, Roane, Robertson, Rutherford, Scott, Sequatchie, Sevier, Shelby, Smith, Stewart, Sullivan, Sumner, Tipton, Trousdale, Unicoi, Union, Van Buren, Warren, Washington, Wayne, Weakley, White, Williamson, and Wilson. The chief cities and towns are: Nashville, the capital, which in 1870 had 25,865 inhabitants; Brownsville, 2,457; Chattanooga, 6,093; Clarksville, 3,200; Columbia, 2,550; Gallatin, 2,123; Jackson, 4,119; Knoxville, 8,682; Lebanon, 2,073; Memphis, 40,226;

State Seal of Tennessee.

Murfreesboro, 3,502; and Pulaski, 2,070. The population of the state and its rank in the Union at decennial periods, according to the federal census, have been as follows:

| YEARS. | Whites. | Slaves. | Free colored. | Aggregate. | Rank. |
|---|---|---|---|---|---|
| 1790.... | 31,913 | 3,417 | 361 | 35,691 | 17 |
| 1800.... | 91,709 | 13,584 | 309 | 105,602 | 15 |
| 1810.... | 215,875 | 44,535 | 1,317 | 261,727 | 10 |
| 1820.... | 339,927 | 80,107 | 2,737 | 422,771 | 9 |
| 1830.... | 535,746 | 141,603 | 4,555 | 681,904 | 7 |
| 1840.... | 640,627 | 183,059 | 5,524 | 829,210 | 5 |
| 1850.... | 756,836 | 239,459 | 6,422 | 1,002,717 | 5 |
| 1860.... | 826,722 | 275,719 | 7,300 | 1,109,801 | 10 |
| 1870.... | 936,119 | ....... | 322,331 | 1,258,520 | 9 |

Included in the aggregate of 1860 are 60 Indians, and 70 in that of 1870. Of the total population in 1870, 623,347 were males and 635,173 females; 1,239,204 were of native and 19,316 of foreign birth. Of the natives, 1,027,653 were born in the state, 20,217 in Alabama, 18,021 in Georgia, 19,867 in Kentucky, 15,451 in Mississippi, 51,110 in North Carolina, 4,420 in Ohio, 4,074 in Pennsylvania,

13,854 in South Carolina, and 43,387 in Virginia and West Virginia. Of the foreigners, 4,539 were born in Germany, 2,085 in England, and 8,048 in Ireland. The density of population according to the federal census was 27·6 persons to a square mile. There were 231,365 families, with an average of 5·44 persons to each, and 224,816 dwellings, with an average of 5·6 to each. The increase of population from 1860 to 1870 was 13·4 per cent. There were 429,592 persons from 5 to 18 years of age, 222,903 males from 18 to 45, and 259,016 male citizens 21 years old and upward. There were 290,549 persons 10 years of age and upward who could not read, and 364,697 unable to write; of the latter, 178,725 were white and 185,952 colored, 163,206 males and 201,473 females; 225,724 were 21 years old and over. The number of paupers supported during the year ending June 1, 1870, was 1,349, at a cost of $99,811. Of the 1,332 receiving support at that date, 314 were colored. The number of persons convicted of crime during the year was 722. Of the 981 in prison June 1, 1870, 560 were colored. The state contained 876 blind, 570 deaf and dumb, 925 insane, and 1,091 idiotic. Of the total population 10 years old and over (890,872), there were engaged in all occupations, 367,987; in agriculture, 267,020, of whom 136,925 were laborers and 129,550 farmers and planters; in professional and personal services, 54,396, including 1,256 clergymen, 24,563 domestic servants, 16,780 laborers not specified, 1,126 lawyers, 2,220 physicians and surgeons, and 2,250 teachers not specified; in trade and transportation, 17,510; in manufactures and mechanical and mining industries, 29,061. The total number of deaths from all causes was 14,239, being 1·13 per cent. of the entire population; from consumption, 2,377, there being 6 deaths from all causes to 1 from this disease; from pneumonia, 1,298, or 11 deaths from all causes to 1 from this disease. There were 652 deaths from croup, 571 from intermittent and remittent fevers, 729 from cerebro-spinal, enteric, and typhus fevers, and 750 from diarrhœa, dysentery, and enteritis.—The state presents eight great topographical divisions. On its E. border the Unaka, Smoky, Bald, and other mountains, belonging to the Appalachian chain, have an average elevation of 5,000 ft. above the sea, and an area (according to state measurements) of 2,000 sq. m. Between these mountains and the Cumberland table land on the west the valley of East Tennessee comprises a succession of ridges and minor valleys running in almost unbroken lines from N. E. to S. W. The average elevation of this valley is 1,000 ft., and its area 9,200 sq. m. The Cumberland table land rises about 1,000 ft. above the valley of East Tennessee, and has an area of 5,100 sq. m. Its E. side forms an almost continuous N. E. line, and presents an abrupt, rocky rampart. The W. edge is irregular and jagged, with deep coves and valleys. Next on the west, with an average elevation of 1,000 ft. above the sea, and an area of 9,300 sq. m., are the highlands, rim lands, or terrace lands, which extend to the Tennessee river. This division is for the most part a plain, traversed by numerous ravines and streams. In the centre of these highlands is the great central basin, elliptical and resembling the bed of a drained lake; its average depression is about 300 ft. below the highlands, and it has an area of 5,450 sq. m. This whole basin, with the surrounding highlands, is slightly inclined toward the northwest. The next natural division on the west is the western valley, or valley of the Tennessee, 10 or 12 m. wide, with an elevation of 350 ft. above the sea and an area of 1,200 sq. m. The surface is broken and irregular, various subordinate valleys extending from 20 to 25 m. into the highlands. The plateau or slope of West Tennessee, which constitutes the seventh grand division, is a great, gently undulating plain, which slopes toward the Mississippi. It has few rocks, is furrowed with river valleys, and extends westward for an average distance of about 84 m., when it abruptly terminates in a long and steep bluff or escarpment that overlooks the great alluvial bottoms of the Mississippi. It has an area of about 8,850 sq. m., with an average elevation of 500 ft. The extreme western natural division comprises the bottoms of the Mississippi, a low, flat, alluvial plain, having an area of 900 sq. m. and an average elevation of about 300 ft. It is covered with forests, and has numerous lakes and morasses. The state is also popularly divided into East, Middle, and West Tennessee; the first extending from the North Carolina border to about the middle of the Cumberland table land, the second from this line to the Tennessee river, and the third from the Tennessee to the Mississippi.—The rivers of Tennessee afford extensive commercial facilities and abundant water power. The most important are the Mississippi, which forms the W. border, and the Tennessee and the Cumberland, which with their tributaries drain more than three fourths of the state. The chief tributaries of the Mississippi are the Forked Deer and its branches (Obion river and South Forked Deer), the Big Hatchie, and Wolf river. The Forked Deer is navigable for steamboats to Dyersburg, and the Big Hatchie for several miles. (See Cumberland River, and Tennessee River.)—Geologically the state is divided into five districts or cross belts running from N. E. to S. W. The first, comprising the interval between the Mississippi and Tennessee rivers, is occupied (in an order from W. to E.) by the alluvial, tertiary, and cretaceous formations of the gulf of Mexico and the Atlantic seaboard. The second, from the Tennessee river to the W. foot of the Cumberland mountains, is a rolling country of nearly horizontal palæozoic rocks, with a great basin-like district of lower Silurian ground in the centre, watered by the Cumberland, Stone's, Duck, and

Elk rivers, and surrounded on all sides by subcarboniferous hills. The third is the mountain division of the coal; a plateau 2,000 ft. above the sea, 40 m. wide by 140 m. long, bounded E. by the valleys of the upper Tennessee and Holston rivers, and covered with a plate of carboniferous rocks, which is thinned and broken up into patches and mounds as it approaches the Alabama state line. The fourth district is the great valley of Knoxville or East Tennessee. It is a prolongation of the great valley of Virginia, the valley of the Shenandoah, and that of Harrisburg and Reading, Pa. Its rocks are mainly of Silurian age, upturned and broken by enormous faults, which bring them against the coal. On its E. side rise the Unaka mountains and their continuations, forming a fifth district, the true prolongation of the Blue Ridge and South mountain range, extending laterally into North Carolina, and composed of rocks of the lower periods of the Silurian age, the equivalents of the slate rock, gneiss, and marble of western Massachusetts and Vermont, and partly of "calciferous sand rock" age. The most abundant and valuable minerals of Tennessee are coal, iron, and copper. The state is crossed by the great Alleghany coal field, which extends from Pennsylvania to Alabama. In Tennessee it is nearly coextensive with the Cumberland table land, and forms an irregular quadrilateral 71 m. wide at the N. end and 50 m. at the S. It covers about 5,100 sq. m. The amount of coal has been estimated at 42,127,360,000 tons. The production of the state in 1870, according to the federal census, was 3,335,450 bushels, valued at $330,498. In 1874 there were 12 mines in operation, producing about 10,000,000 bushels annually. Iron exists in four distinct belts or areas. The eastern belt stretches across the E. part of the state, at the base of the border range of mountains, extending into Virginia on the northeast and Georgia on the southeast. The most abundant ore in this belt is the limonite, which occurs in Johnson, Sevier, Carter, and Blunt cos. There are also veins of magnetite and hematite ore, which will yield from 60 to 70 per cent. of metallic ores. There are five furnaces in this region, capable of producing about 15,000 tons annually; but owing to the lack of railroad facilities the amount produced does not exceed 10,000 tons. Iron ore containing oxide of manganese is abundant in Greene co., from which spiegeleisen is made. The dyestone belt skirts the E. base of the Cumberland table land, extending beyond the limits of the state on the northeast and southeast. In Tennessee it reaches from Chattanooga to Cumberland gap, about 150 m.; it spreads out laterally from 10 to 20 m. into the valley of East Tennessee, and includes the Sequatchie and Elk valleys. The chief ore of this belt is a stratified red iron rock, highly fossiliferous, occurring in layers, and called at many points dyestone, being sometimes used for dyeing. The ore is a variety of hematite, and yields from 50 to 60 per cent. of iron. There are four furnaces in this region. The Cumberland table-land belt of iron ore is coextensive with the coal field. The ore lies interstratified with shale, sandstone, and coal. It is called clay ironstone, and is an argillaceous carbonate of iron. It is inferior in quality, producing rarely more than 30 per cent., and usually not more than 20 per cent. of iron, and has not been worked. The western iron belt crosses the state N. and S., and lies mainly between the central basin and the Tennessee river, though extending in some counties a few miles W. of the river. It is about 50 m. wide, and embraces an area of about 5,400 sq. m. But the ore is found in available quantities only at certain points called "banks," some of which are miles in extent, while others occupy only a few acres. Some of these banks have been worked for 80 years with no signs of exhaustion. The ore is a limonite or brown hematite, some of it being inferior in quality; in other places the yield of iron is from 40 to 55 per cent. There are 11 furnaces in this region, with a monthly capacity of about 4,230 tons. Tennessee has decided advantages for making iron, in the abundance, cheapness, and contiguity of ore and of fuel; the disadvantages are distance from market and want of transportation facilities. Valuable deposits of copper are found in Polk co. in the S. E. corner of the state, covering an area of 40 sq. m. The ore is smelted by two extensive companies at Ducktown, having 25 furnaces and employing about 900 hands. From 1865 to 1874 the larger of these companies produced 8,476,872 lbs. of ingot copper. Tennessee is rich in marble, which is found in every part of the state, the varieties including black, gray, magnesian, fawn-colored, white, red, variegated, conglomerate, and breccia. Many quarries are worked. Limestone and other building stone abound in various parts of the state. Slate is common, but little of it is valuable. Several beds of millstone have been found, the most noteworthy being in Claiborne co. Hydraulic rocks abound in many counties, especially in Hardin, Wayne, Perry, Decatur, Warren, and Montgomery, and in Knox and McMinn cos. in East Tennessee. Lithographic stone of an excellent quality occurs in McMinn co. Granite of various shades of color, some of it rivalling the Scotch granite, is found in Carter co.; and unakite, a greenish compact granite, in the Unaka mountains, being peculiar to that locality. Deposits of potter's clay are found in East Tennessee, on the Knoxville and Ohio railroad, and in the vicinity of the lower Tennessee river, in the counties of Hickman, Henry, Perry, and Wayne; also in Montgomery and Houston cos. Some of this clay has been worked up into stone ware. There are numerous potteries, the largest being in Memphis, Nashville, and Knoxville. Kaolin is found in Carter co. Fire clay is found in Stewart and Houston cos.

and on the Cumberland river. It also exists in the coal measures immediately underlying a seam of coal. Lead occurs in various places in East and Middle Tennessee. Mines have been worked in Washington, Monroe, and Bradley cos.; one of the most promising is the Caldwell mine on Powell's river in Union co. This vein, which fills a nearly vertical fissure, about 20 in. wide, in nearly horizontal rocks, can be traced about a mile. The two ores of zinc, smithsonite and calamine, occur in considerable deposits in various localities, especially in Claiborne, Union, and Jefferson cos.; they are in greatest abundance in Union co. The Stiner belt, near Powell's river, is 50 or 60 ft. wide, and is marked by the absence of trees. The lead and zinc ores are often associated. Black oxide of manganese is found in small masses, associated with iron, all over the state. Iron pyrites also exists everywhere in the state; a large quantity is found associated with the copper at Ducktown. Large beds also occur near Greeneville in Greene co., and in Moore, Carter, and Perry cos. Heavy spar or baryta, used for cheap paints, is found in Middle and East Tennessee; it is mined in Greene, Washington, Jefferson, and some other counties. It is usually associated with lead, constituting the gangue of that mineral. Asbestus exists in large quantities in Cocke co. Copperas is abundant, and specimens of gypsum have been found. Salt was formerly made in the state, but its manufacture has been discontinued. Saltpetre abounds in numerous caves throughout Middle and East Tennessee. Petroleum has been found at various points, and 10,000 barrels of it has been obtained from the wells near Spring creek in Overton co.; but the production has not been found profitable. Extensive beds of lignite are found in many of the counties of West Tennessee. Alum occurs in the same situations as copperas in Middle Tennessee, Epsom salts in many of the saltpetre caves, and large quantities of bluestone (sulphate of copper) at Ducktown. The state collection of minerals in the capitol comprises, besides a great variety of specimens, 200 kinds of marble, of all colors from Parian white to jet black, all found in the state. Tennessee has marked advantages in the number, variety, excellence, and medicinal value of its mineral waters. Mineral springs occur upon the lofty peaks of the Unakas and along the bases of the long ridges of the eastern valley. The Cumberland table land abounds with sparkling chalybeate springs. There are also valuable sulphur and chalybeate springs in West Tennessee.—Tennessee has numerous caves, many of which were explored in 1811–'12 for the saltpetre earth in them, and a large amount of nitre was then manufactured from the earthy material thus obtained. In the Cumberland mountains are several caves which are 100 ft. or more below the surface and several miles in extent. One has been descended to a depth of 400 ft., where a stream of water was found having sufficient force and fall to drive a mill. Another, on the summit of Cumberland mountain, is perpendicular in its descent, and its depth has never yet been fathomed. Some of these caves contain fossils and bones of extinct species of animals; others, large deposits of the excrement of bats, valuable as a fertilizer. Big Bone cave when first explored contained bones of the mastodon. There are throughout the cavernous limestone region occasional "sink holes," as they are termed. These are hopper-shaped cavities on the surface which communicate with the caves and underground streams. Near Manchester, Coffee co., is an ancient work called the Stone Fort, enclosed by a rude stone embankment by tourists called a wall, upon which trees are growing, whose age is estimated at over 500 years. This mysterious enclosure lies in a peninsula formed by the near approach of two forks of Duck river, and occupies an area of 37 acres.—The climate is generally mild and remarkably salubrious, excepting in the swampy districts of West Tennessee. The eastern division is noted for its pure mountain air. The mean annual temperature along a line running E. and W. through the middle of the state is about 57° in the valley of East Tennessee, 58° in Middle, and 59° in West Tennessee. The temperature is about one degree higher along the southern, and about one degree lower along the northern boundary. Going from W. to E. there is a difference of elevation of more than 6,000 ft., which gives a wide range of climate and great variety in vegetable productions.—East Tennessee, excluding its great valley, has a limited surface adapted to cultivation. The soil of Middle Tennessee is generally good, producing large crops of wheat, rye, oats, Indian corn, buckwheat, barley, potatoes, hemp, hay, sweet potatoes, flax, cotton, and tobacco. The western division is almost level, and cotton, tobacco, and all kinds of grain are grown in extraordinary abundance. The soil of this part is a rich black mould. Along the banks of the Mississippi and Tennessee are extensive cane brakes, covered with reeds. The country is well watered. The N. W. part contains an extensive tract of swampy land. Nearly half of the state is wooded land, and presents almost every variety of timber found in the United States. West Tennessee is specially noted for the magnificence of its forests. The high mountains in the east are covered with forests of pine, which yield tar, pitch, turpentine, and lumber for export; white pine, chestnut, hemlock, and black walnut grow to immense size in the coves of the mountains. On the mountain slopes the sugar maple, ash, cedar, juniper, and savin are also abundant; and in the lower lands as well as in Middle Tennessee the poplar, hickory, black walnut, oak, beech, locust, and cherry are found. The most extensive red cedar forests in the United States are found in the central basin of Middle Tennessee. In the swamps and low lands of

West Tennessee the cypress, hackmatack, cottonwood, and swamp cedar occur in large quantities. Several wild or indigenous grasses grow spontaneously. The pawpaw, a low bushy tree or shrub, bearing a fruit somewhat resembling the banana, though inferior to it, is found in the river bottoms. The persimmon, which is common, yields a fruit which in sweetness and pleasantness of flavor equals the date. The black haw, red haw, wild plum, blackberry, wood grape, muscadine, strawberry, whortleberry, gooseberry, and service berry all grow wild and yield luxuriantly. Nuts of various kinds abound, as the walnut, hickory nut, hazel nut, chestnut, pecan, and chinquapin, all forming articles of export. Ginseng is found on all the elevated lands. The wild animals are the bear, found only in the mountainous districts, deer, raccoons, foxes, opossums, and squirrels. Horses, cattle, sheep, and swine are raised on a large scale, and many thousands are annually exported. The hills and mountain slopes afford an abundance of fine pasturage. Much attention is given to wool growing.—According to the federal census of 1870, the state contained in farms 6,843,278 acres of improved land, 10,771,396 of woodland, and 1,966,540 of other unimproved land. The total number of farms was 118,141, containing an average of 166 acres each; 18,806 contained from 100 to 500 acres, 412 from 500 to 1,000, and 50 over 1,000. The cash value of farms was $218,743,747, of farming implements and machinery $8,199,487. The staple crops of 1873 were reported as follows by the United States department of agriculture:

| CROPS. | Bushels. | Yield per acre. | Acres. | Total value. |
|---|---|---|---|---|
| Indian corn.... | 42,604,000 | 22·5 | 1,893,511 | $24,710,320 |
| Wheat......... | 7,414,000 | 7·2 | 1,029,722 | 9,860,620 |
| Rye........... | 204,000 | 9 | 22,667 | 183,600 |
| Oats........... | 5,613,000 | 20·6 | 272,476 | 2,301.330 |
| Barley......... | 83,000 | 19·2 | 4,323 | 70,550 |
| Buckwheat.... | 74,000 | 10·5 | 7,047 | 70,300 |
| Potatoes....... | 1,009,000 | 75 | 13,453 | 665,940 |
| Tobacco (lbs.).. | 23,750,000 | 675 | 35,185 | 1,425,000 |
| Hay (tons)..... | 134,500 | 1·25 | 107,600 | 2,084,750 |

The total value of these crops was $41,372,410; whole number of acres, 3,385,984. The number and value of domestic animals in 1874 were reported as follows:

| ANIMALS. | Number. | Average price. | Total value. |
|---|---|---|---|
| Horses.................... | 302,900 | $77 51 | $23,477,779 |
| Mules..................... | 103,200 | 90 84 | 9,374,688 |
| Oxen and other cattle..... | 355,100 | 14 22 | 5,049,522 |
| Milch cows... ........... | 247,700 | 21 86 | 5,414,722 |
| Sheep..................... | 350,000 | 2 09 | 731,500 |
| Swine..................... | 1,420,900 | 3 09 | 4,390,581 |

Peanuts, constituting an important crop, are raised in the counties of Perry, Hickman, and Humphreys, and parts of Dickson and Lewis, all of which are on the W. side of the Highland rim. The production amounted to 680,000 bushels in 1872, 110,000 in 1873, 200,000 in 1874, and 250,000 in 1875. The average yield is about 40 bushels an acre. The shipment of cotton from Tennessee amounted to 378,813 bales in 1872–'3, 489,534 in 1873–'4, and 446,674 in 1874–'5, most of which was the product of the state. In 1873 there were 613,267 acres planted with cotton. The best grows in the S. half of West Tennessee; it is grown in the whole of the central basin S. of Nashville. As a tobacco-growing state Tennessee ranks third, Kentucky being first and Virginia second. The annual product of the state varies from 20,000,000 to 25,000,000 lbs., or from 13,000 to 22,000 hogsheads. The average yield per acre is between 700 and 800 lbs., though as much as 1,800 lbs. can be produced upon the best soils in good seasons. The soil and climate are well adapted to the cultivation of grapes; much attention has recently been given to this industry, and also to the production of honey.—The total number of manufacturing establishments, according to the census of 1870, was 5,317, using 732 steam engines of 18,467 horse power and 1,340 water wheels of 19,514 horse power, and employing 19,412 hands, of whom 17,663 were males above 16 years of age, 1,089 females above 15, and 660 youth. The amount of capital invested was $15,595,295; wages, $5,390,630; materials, $19,657,027; products, $34,362,636. The statistics of the most important industries were reported as follows:

| INDUSTRIES. | No. of establishments. | No. of hands employed. | Capital. | Value of products. |
|---|---|---|---|---|
| Agricultural implements... | 25 | 110 | $62.900 | $182.772 |
| Blacksmithing ............ | 719 | 1,445 | 230,897 | 873,888 |
| Boots and shoes........... | 309 | 707 | 181.601 | 665,522 |
| Carpentering and building. | 333 | 847 | 250,595 | 1.149,598 |
| Carriages and wagons..... | 220 | 818 | 495,280 | 935.647 |
| Cotton goods............. | 28 | 890 | 970,650 | 941,542 |
| Flouring and grist-mill products................. | 1,058 | 2,218 | 2,891.484 | 10.767,388 |
| Furniture................. | 89 | 485 | 231.310 | 404.588 |
| Iron, blooms.............. | 2 | 26 | 91,750 | 15,600 |
| " forged and rolled..... | 18 | 837 | 253,750 | 869,222 |
| " nails and spikes, cut and wrought....... | 1 | 8 | 8,000 | 5,000 |
| " railing, wrought...... | 1 | 6 | 1.500 | 6.292 |
| " pigs ................. | 14 | 1,122 | 1,103.750 | 1,147,707 |
| " castings.............. | 33 | 316 | 69.721 | 555,111 |
| Leather, tanned........... | 209 | 453 | 451,097 | 921,497 |
| " curried........... | 186 | 309 | 249.568 | 922.641 |
| " morocco.......... | 1 | 7 | 5,000 | 7.500 |
| Liquors, distilled.......... | 44 | 218 | 215.650 | 454.858 |
| " malt............. | 6 | 84 | 57.700 | 194.240 |
| Lumber, planed........... | 22 | 191 | 168.875 | 528.550 |
| " sawed............ | 702 | 2,910 | 1,622.741 | 3,390,687 |
| Machinery, not specified... | 21 | 211 | 224.900 | 887,450 |
| " cotton and woollen | 12 | 66 | 67.950 | 101.200 |
| " railroad repairing. | 3 | 142 | 165,162 | 201,455 |
| " steam engines and boilers......... | 7 | 103 | 133.500 | 214.700 |
| Oil, cotton-seed .......... | 4 | 161 | 190,000 | 490,000 |
| Patent medicines and compounds.................. | 10 | 84 | 44.150 | 249,150 |
| Printing, newspaper....... | 28 | 885 | 474.800 | 911,400 |
| Saddlery and harness...... | 161 | 421 | 248,405 | 650.071 |
| Sash, doors, and blinds..... | 11 | 162 | 127,100 | 856,280 |
| Tin, copper, and sheet-iron ware.................. | 76 | 289 | 250.850 | 487,551 |
| Wooden ware............. | 4 | 72 | 40.510 | 139,100 |
| Wool-carding and cloth-dressing................ | 133 | 265 | 185.798 | 491,847 |
| Woollen goods......... .. | 15 | 163 | 188,075 | 204.997 |

There has been a marked progress in many industries since 1870, especially in the manufacture of cotton, iron, liquors, and carriages and wagons. In 1875 there were 40 cotton mills with 55,384 spindles; cotton consumed during the year, 6,701,718 lbs., or 14,443 bales. There are no United States customs districts in Tennessee, but Memphis and Nashville are ports of delivery in the district of Louisiana. At the close of 1875 there were 27 national banks in operation, with a capital stock of $3,455,300 and a circulation of $2,474,323.—Tennessee had 466 m. of railroad in 1855, 1,253 in 1860, 1,296 in 1865, 1,492 in 1870, and 1,641 in 1875. The lines lying wholly or partly in the state in 1875 were as follows:

| NAMES OF CORPORATIONS. | TERMINI. | | Miles completed in the state in 1875. | Total length between termini when different from preceding. |
|---|---|---|---|---|
| | FROM | TO | | |
| East Tennessee, Virginia, and Georgia | Bristol | Dalton, Ga | 225 | 240 |
| | Cleveland | Chattanooga | 30 | .... |
| Owned.. Cincinnati, Cumberland Gap, and Charleston | Morristown | Wolf Creek | 39 | .... |
| Owned.. Knoxville and Ohio | Knoxville | Careyville | 38 | .... |
| Owned.. Rogersville and Jefferson | Junction E. S. V. and G. | Rogersville | 15 | .... |
| Knoxville and Charleston | Knoxville | Maryville | 16 | .... |
| Louisville, Nashville, and Great Southern | Louisville, Ky | Nashville | 46 | 185 |
| Memphis division | Memphis Junction, Ky | Memphis | 214 | 260 |
| Leased, Nashville and Decatur | Nashville | Decatur, Ala | 94 | 123 |
| Memphis and Charleston | Memphis | Stevenson, Ala | 87 | 271 |
| Branch | Moscow | Somerville | 13 | .... |
| Operated McMinnville and Manchester | Tullahoma | McMinnville | 34 | .... |
| Operated Winchester and Alabama | Decherd | Fayetteville | 37 | .... |
| Mississippi and Tennessee | Memphis | Grenada, Miss | 12 | 100 |
| Mobile and Ohio | Columbus, Ky | Mobile, Ala | 122 | 472 |
| Nashville, Chattanooga, and St. Louis | Hickman, Ky | Chattanooga | 287 | 321 |
| Branches | Wartrace | Shelbyville | 9 | .... |
| | Bridgeport, Ala | Jasper | 11 | 14 |
| New Orleans, St. Louis, and Chicago | New Orleans, La | Cairo, Ill | 100 | 548 |
| Paducah and Memphis | Paducah, Ky | Memphis | 115 | 165 |
| St. Louis and Southeastern | East St. Louis, Ill | Nashville | 48 | 316 |
| Tennessee and Pacific | Nashville | Knoxville | 31 | 180 |
| Western and Atlantic | Atlanta, Ga | Chattanooga | 18 | 138 |

—The governor is elected for two years, and receives an annual salary of $4,000. He must be 30 years of age and a citizen of the state for seven years next preceding his election. He is not eligible for more than six years in any period of eight. In case of the removal of the governor from office, or of his death or resignation, the executive functions devolve upon the speaker elected by the senate. The secretary of state is elected for four years by joint vote of the general assembly, and receives a salary of $1,800 a year and perquisites. A bill may be passed over the executive veto by a majority vote of each house. The state treasurer and comptroller are appointed by the general assembly for two years. The constitution provides that the number of representatives in the legislature shall not exceed 75 until the population of the state shall be 1,500,000, and shall never exceed 99. The number of senators is limited to one third of the number of representatives. There are now (1876) 25 senators and 75 representatives. The sessions of the legislature are biennial, beginning on the first Monday of January in odd years. Senators and representatives receive $4 a day and $4 for every 25 miles travel to and from the capital. No member will be paid for more than 75 days of a regular session, or for more than 20 days of an extra session, or for any days when absent from his seat. The judicial power is vested in a supreme court and chancery, circuit, county, and justices' courts. The supreme court consists of a chief justice and five associates, who are elected by the people for eight years, and receive a salary of $4,000 each. Its jurisdiction is appellate only. Terms are held annually in Knoxville, Nashville, and Jackson. The attorney general and reporter for the state is appointed by the judges of the supreme court. Judges of the circuit and chancery courts are elected by the people for eight years. Two terms of the chancery court are held in each county annually. They have all the powers and jurisdiction incident to a court of equity, and exclusive jurisdiction of all equity cases where the amount in controversy exceeds $50. They have jurisdiction with the county courts over the person and property of persons of unsound mind, and of infants. Three terms of the circuit court are annually held in each county. Concurrently with justices of the peace they have jurisdiction of all debts and demands on contract over $50, and exclusive jurisdiction of matters relating to the validity of wills; also appellate jurisdiction of all suits brought before inferior tribunals. Each county has a court consisting of the justices of the county, which has jurisdiction of probate matters. Justices of the peace are elected by the people for six years, and constables for two years. Judges may be removed from office by a two-thirds vote of the legislature. They are prohibited from charging juries with respect to matters of fact, but may state the testimony and declare the law. Fines exceeding $50 on any citizen must be assessed by a jury. The right

of suffrage is given to every male person of the age of 21 years who is a citizen of the United States and a resident of Tennessee for one year, and of the county where he offers to vote for six months. There is no other qualification except the payment of a poll tax of not less than 50 cents nor more than $1 a year. In 1867 the state gave to negroes the right to vote. Elections for governor and members of the general assembly are held biennially in even years, on the first Tuesday after the first Monday in November; for judicial and other civil officers, on the first Thursday in August. Ministers of the gospel and priests are ineligible as members of the legislature. No person who denies the being of God or a future state of rewards and punishments can hold any civil office. Any person who has engaged in a duel or preparations for a duel, either as principal or second, is disqualified from holding any office of honor or profit, besides being subject to punishment by law. Amendments to the constitution may be proposed in either branch of the general assembly; before taking effect they must be approved by a majority of the members elected to each house of the general assembly when first proposed, by two thirds of the next legislature, and subsequently by a popular vote. The grounds of divorce are: impotence, adultery, desertion for two years, conviction of an infamous crime or of felony, malicious attempt upon the life of the wife, pregnancy by another man at the time of marriage without the husband's knowledge, cruelty, indignities by the husband forcing the wife to separation, abandonment of the wife or turning her out of doors, and refusal to provide for her. The legal rate of interest is 6 per cent., but any rate not exceeding 10 per cent. may be contracted for in writing; if more than 10 per cent. is agreed upon, only 6 per cent. can be collected. Usury is punishable by a fine of not less than $100. Tennessee is represented in congress by 10 representatives and 2 senators, and has therefore 12 votes in the electoral college.—On Dec. 19, 1874, the bonded debt of the state was $22,908,400, which was largely contracted by the indorsement of railroad bonds. The assets of the state on bond account amounted to $3,817,896. The state revenue during 1873 and 1874, not including bonds or coupons paid by railroad companies, amounted to $3,618,703, and the disbursements to $3,290,158. According to the federal census, the true value of property was $201,246,686 in 1850, $493,903,892 in 1860, and $498,237,724 in 1870. The assessed value of all taxable property, as reported by the state authorities, was $308,089,738 in 1873 and $289,533,656 in 1874. The amount of state tax levied in 1873 was: East Tennessee, $254,200; Middle, $542,686; West, $435,472; total, $1,232,358. In 1874 it was: East Tennessee, $192,913; Middle, $401,563; West, $410,190; total, $1,005,066. The total valuation of taxable property in 1872 was $265,874,258; taxation, $1,090,694. The constitution provides that all property shall be taxed according to its value, so that the taxes shall be equal and uniform throughout the state, and that no species of property shall be taxed higher than any other of the same value. But the legislature is empowered to except from taxation property held by the state, counties, cities, or towns, and used exclusively for public or corporation purposes, and such as may be held and used for purposes purely religious, charitable, scientific, literary, or educational. In 1875 the comptroller reported that no railroad company had ever paid any taxes to the state; and that no corporations, excepting insurance companies and a few banks, had paid the taxes levied by law.—The state prison is in Nashville, and there are also several temporary prisons in various parts of the state, where convicts are employed upon railroads, mines, &c. The total number in confinement during the two years ending Dec. 1, 1874, was 1,625, of whom 744 were held on Dec. 1, 1872; 881 were received during that period, and 963 were in confinement at the end. Of the last number, 380 were white and 583 colored; 925 were males and 38 females; 13 had a good and 97 a fair education, 199 could read and write, and 654 had no education; 34 were under 16 years of age, and 275 under 21; 21 were sentenced for life, and 69 for 20 years or longer. The prisoners are employed under lease on public works, buildings, railroads, &c. The revenue thus received is reported to be greater than the cost of supporting the prison. There is preaching and Sunday school instruction. The state hospital for the insane, near Nashville, was opened in 1852. The average daily number of patients during the two years ending with 1874 was 379; the whole number under treatment during that period was 561, of whom 374 remained on Jan. 1, 1875. Of the latter, all but 37 were maintained free of charge. The cost of maintaining the institution during the two years named was $157,987. The accommodations of the hospital are inadequate, the number of insane in the state being estimated at not less than 1,200. The Tennessee school for the blind, in Nashville, opened in 1844, had 55 pupils in 1874. Its cost during that year was $33,890. It is estimated that there are not fewer than 1,200 blind in the state. This school has recently been very much enlarged. The Tennessee deaf and dumb school is in Knoxville, and was opened in 1845. The number of pupils in attendance during the two years ending with 1874 was 155, of whom 121 remained on Jan. 1, 1875. There were seven instructors. The ordinary expenditures during this period amounted to $53,356.—There was no satisfactory system of common schools in Tennessee prior to 1873, when the present law providing for a general state system was enacted. The school fund, which had been lost or diverted to other purposes, was restored, together with the suspended interest. A per-

manent fund, amounting in 1875 to $2,512,-500, was thus secured; the interest on this, at the rate of 6 per cent. per annum, is distributed semi-annually among the counties according to school population. The law also authorizes for school purposes a poll tax of $1, and a tax of one mill on the dollar upon all the taxable property of the state, and provides that when the money derived from the school fund and the taxes imposed by the state shall be insufficient to support a public school for five months in the year in each of the districts in any county, the county court shall levy an additional tax for the purpose, or submit the proposition to a vote of the people. About one half of the counties of the state have levied an additional tax to prolong the schools. The total annual income from the permanent fund and state taxation is about $600,000. The state superintendent of public instruction is appointed for two years, and receives an annual salary of $3,000. County superintendents are elected biennially by the county courts. Three directors are elected in each district for three years. The public schools are free to all persons between the ages of 6 and 18 years; but there must be separate schools for colored persons. The school population (one county not reporting) on June 30, 1875, was 425,901; white, 319,671; colored, 106,230. The number of pupils enrolled (one county not reporting) was 198,085; average attendance (16 counties not reporting), 136,118; number of schools (13 counties not reporting), 3,942; school revenue, $740,316; total expenditures, $703,358. In 1873-'4 public schools in various parts of the state received aid from the Peabody education fund to the extent of $34,300. The state normal university, under the control of the state board of education, was opened as a department of the university of Nashville in December, 1875. It has an annual revenue of $6,000 from the Peabody education fund and $6,000 from the university of Nashville. Normal instruction is also afforded in several of the colleges. In several of the cities there are efficient systems of free schools, supported in part by the cities and in part from the state and county school revenues. The universities and colleges of Tennessee, with the number of instructors and pupils in 1874-'5, were as follows:

| NAME OF INSTITUTION. | When opened. | Where situated. | Denomination. | No. of instructors. | No. of pupils in collegiate department. | No. of pupils in all departments. |
|---|---|---|---|---|---|---|
| Beech Grove college | 1868 | Beech Grove | None | 4 | 23 | 135 |
| Central Tennessee college | 1866 | Nashville | Methodist Episcopal | 9 | 2 | 240 |
| Christian Brothers' college | 1871 | Memphis | Roman Catholic | 9 | 48 | 127 |
| Cumberland university | 1842 | Lebanon | Cumberland Presbyterian | 13 | 151 | 391 |
| East Tennessee university | 1869 | Knoxville | None | 15 | 101 | 315 |
| East Tennessee Wesleyan university | 1867 | Athens | Methodist Episcopal | 7 | 16 | 86 |
| Fisk university | 1866 | Nashville | None | 16 | 10 | 262 |
| Greenville and Tusculum college | 1868 | Greenville | Presbyterian | 9 | 71 | 112 |
| Hiawassee college | 1849 | Sweetwater (near) | Methodist Episcopal, South | 5 | 80 | 137 |
| King college | 1868 | Bristol | Presbyterian | 5 | 40 | 84 |
| Maryville college | 1819 | Maryville | " | 11 | 21 | 94 |
| Stewart college | .... | Clarksville | ........ | 4 | 48 | 104 |
| Southwestern Baptist university | 1875 | Jackson | Baptist | .. | .. | ... |
| Union university | 1848 | Murfreesboro | ........ | .. | .. | ... |
| University of Nashville | 1785 | Nashville | None | 7 | 22 | 188 |
| University of the South | 1868 | Sewanee | Protestant Episcopal | 19 | 124 | 262 |
| Vanderbilt university | 1875 | Nashville | Methodist Episcopal, South | 27 | 140 | 300 |

The East Tennessee university embraces the state college of agriculture and the mechanical arts, for which provision was made by congress in 1862. The university was organized in 1840 (the East Tennessee college having been opened in 1808), and the agricultural college in 1869. There are three courses of study of four years each, agricultural, mechanical, and classical; and two preparatory courses of three years each. Each senator is entitled to name two, and each representative three students, who may attend the institution without charge for tuition, and may also pass free on railroads between their homes and the university. For others, the annual cost of tuition is $36 in the college and $30 in the preparatory department. Students are required to perform manual labor during the freshman and sophomore years. The university has a considerable library, and cabinets of geology, mineralogy, and zoölogy. The university of the South, at Sewanee, is under the control of the Protestant Episcopal church. It has separate schools for each department of learning. The institution has about 10,000 acres of land on a plateau of the Cumberland mountains, 2,000 ft. above the sea and 1,000 ft. above the surrounding country. Owing to the favorable climate of this elevation, studies are continued during the summer, and a long vacation occurs in the winter. The university has a library of over 5,000 volumes. The East Tennessee Wesleyan university, at Athens, has a collegiate department, with classical and scientific courses, and preparatory and academic departments. Fisk university was organized in 1866 through the efforts of the American missionary association of New York. It is designed for the instruction of colored persons, and has made the training of teachers a prominent part of its work. It was named after Gen. C. B. Fisk, then commissioner of the freedmen's bureau, through whose efforts government buildings were obtained for the institution. Since 1871 upward

of $100,000 have been raised for it by concerts given in the north and in Great Britain by the "Jubilee Singers." With this money 25 acres of land have been purchased, on which has been erected Jubilee hall, 128 by 145 ft. and six stories high. For the university of Nashville and Central Tennessee college, see Nashville; for Cumberland university, see Lebanon; see also Vanderbilt University. Instruction in theology is provided by Central Tennessee college; in law, theology, and medicine, by Cumberland and Vanderbilt universities; and in medicine and surgery, by the university of Nashville and the Tennessee college of pharmacy in Nashville. The last named was organized in 1872, and in 1875–'6 had seven instructors. In 1870 the state contained 3,505 libraries with an aggregate of 802,112 volumes. Of these, 2,732 with 597,399 volumes were private, and 773 with 204,713 other than private, including the state library of 19,000 volumes. The total number of newspapers and periodicals in 1875 was 141, including 9 daily, 1 tri-weekly, 1 semi-weekly, 110 weekly, 1 bi-weekly, 1 semi-monthly, 17 monthly, and 1 quarterly. In 1870 there were 3,180 religious organizations, having 2,842 edifices with 878,524 sittings, and property valued at $4,697,675, divided as follows:

| DENOMINATIONS. | Organizations. | Edifices. | Sittings. | Property. |
|---|---|---|---|---|
| Baptist, regular | 942 | 877 | 245,151 | $843,675 |
| " other | 45 | 41 | 10,225 | 16,400 |
| Christian | 203 | 167 | 55,455 | 244,625 |
| Congregational | 3 | 2 | 525 | 14,100 |
| Episcopal, Protestant | 33 | 31 | 12,940 | 269,573 |
| Friends | 5 | 4 | 1,900 | 4,800 |
| Jewish | 4 | 4 | 1,100 | 21,000 |
| Lutheran | 22 | 22 | 9,875 | 27,664 |
| Methodist | 1,339 | 1,155 | 336,433 | 1,506,153 |
| Presbyterian, regular | 262 | 241 | 83,590 | 858,105 |
| " other | 294 | 271 | 105,380 | 400,230 |
| Roman Catholic | 21 | 21 | 13,850 | 486,250 |
| United Brethren in Christ | 7 | 5 | 1,600 | 4,100 |
| Unknown (union) | ... | 1 | 500 | 1,000 |

—The name of Tennessee is derived from Tannassee, the Indian name of the Little Tennessee river. De Soto probably visited the spot where Memphis now stands. The first settlement was attempted in 1754 by a small body of North Carolinians, but they were speedily driven from the country by the Indians. In 1756 the first permanent settlement was made, and Fort Loudon built on the Tennessee river about 30 m. from the present site of Knoxville. This was the first Anglo-American settlement W. of the Alleghanies and S. of Pennsylvania. In 1760 the fort was besieged by the Indians, and the whites capitulated, stipulating that they should be allowed to return to North Carolina. On the second day of their march they were overtaken by the savages and many of them butchered, and the survivors reduced to captivity. In 1761 another armed force from Virginia and North Carolina entered the district, and after a number of successful battles with the Indians compelled them to sue for peace. A treaty was made with them, and the settlements along the Watauga and Holston rivers increased rapidly, being known from 1769 to 1777 as the Watauga association. In the colonial assembly of North Carolina in 1776 the territory was represented by deputies as the district of Washington; and in the revolutionary war the settlers flocked to the standard of the colonists. At the close of the revolution a settlement was made on the Cumberland river where Nashville now stands. From 1777 to 1784 the territory formed part of North Carolina, which set apart a portion of the district in the vicinity of Nashville for bounty lands for her revolutionary soldiers. In 1785 the people became dissatisfied with the manner in which they were treated by the government of that state, and organized the state of Franklin, which was maintained until 1788, when it was again united with North Carolina. In 1789 that state ceded the territory to the general government, and in 1790 it was organized, together with Kentucky, as the territory of the United States south of the Ohio. In 1794 a distinct territorial government was granted to Tennessee; and in 1796 a state constitution was formed at Knoxville, and Tennessee was admitted into the Union. The constitution was amended in 1834–'5, and again in 1853. The seat of government was at Knoxville from 1794 to 1811, excepting in 1807, when it was at Kingston; from 1812 to 1815 at Nashville; in 1817 at Knoxville; in 1816 and from 1819 to 1825 at Murfreesboro; and from 1826 to the present time it has been at Nashville. The general assembly of Tennessee was convoked in extra session Jan. 7, 1861, to consider what action should be taken by the state in view of the impending difficulties between the north and the south. In East Tennessee the people were generally opposed to secession; in West Tennessee there was a strong popular sentiment in favor of separation. The governor, Isham G. Harris, actively favored the southern cause. On Feb. 9 the people of the state voted on the question whether a convention should be held to consider the subject of withdrawing from the Union, and also for delegates to the convention. In a total vote of 127,000, there was a majority of nearly 12,000 against a convention. Of those who voted for delegates a majority of about 64,000 were in favor of the Union. The requisition for troops made upon Tennessee by the president after the firing upon Fort Sumter was refused by Gov. Harris, who again summoned the legislature to meet in extra session. Early in May a military league was formed with the Confederate States by commissioners appointed for that purpose, and was ratified by the legislature. On May 6 the legislature again provided for submitting the question of secession to the people. The election was held on June 8, and resulted in a majority of 57,675 for separation, the total vote being 152,151. In East Tennessee there was a large majority in favor

of the Union. Troops were now recruited and armed by the state for the confederate army and to resist invasion from the north. Batteries were erected to command the Mississippi from Memphis to the Kentucky line; troops were concentrated in West Tennessee under Gen. Pillow; and the confederate forces took possession of the three gaps in the mountains of East Tennessee. The invasion of Tennessee by the federal forces was begun early in 1862 by a combined naval and military expedition, which captured Forts Henry and Donelson in February. (See FORT DONELSON.) Nashville, the headquarters of the confederate general A. S. Johnston, was taken a few days afterward, when the state government was removed to Memphis. (See NASHVILLE.) A large portion of the state having now been restored to federal authority, Andrew Johnson was appointed military governor by President Lincoln, and assumed the duties of the office in Nashville on March 12. In the same month a formidable fleet of gunboats left Cairo, Ill., for the purpose of regaining the Mississippi river from confederate control. The advance of this fleet forced the confederates to abandon Island No. 10, Forts Pillow and Randolph, and other strongholds; and on June 6 Memphis was taken by the federal forces after a severe engagement between the gunboats. In November Gen. Rosecrans advanced from Nashville upon Murfreesboro, which was the centre of Gen. Bragg's operations in Tennessee. After a severe engagement lasting several days, the place was abandoned by the confederates, Jan. 4, 1863, and then became the depot of supplies for Gen. Rosecrans's army. The confederates now fell back to Shelbyville, and on the advance of Rosecrans in June retired to Chattanooga, which they abandoned on Sept. 8 upon the approach of Rosecrans. On the 19th and 20th a severe battle was fought about 12 m. S. W. of Chattanooga. (See CHICKAMAUGA.) The Union forces were repulsed, but continued to occupy Chattanooga, which however was besieged by the confederates. In the latter part of November an advance was made upon the confederate lines by Gen. Grant, which resulted in the complete rout of the confederates. In this engagement were fought the battles of Lookout mountain and Missionary ridge. (See CHATTANOOGA.) In the mean time Gen. Burnside had marched into East Tennessee, and he took peaceable possession of Knoxville early in September. In November, 1864, the state was invaded by a confederate force under Gen. Hood. Battles were fought with the federal forces at Franklin and at Nashville, the latter resulting in the complete rout of the confederates, under Gen. Hood, and their retreat from the state. (See NASHVILLE.) During 1864 numerous raids were made in different parts of Tennessee by the confederates. On Jan. 9, 1865, a state convention assembled in Nashville and proposed amendments to the constitution, abolishing slavery and prohibiting the legislature from recognizing property in man. A schedule was adopted annulling the military league made in 1861 with the Confederate States, also the declaration of independence, the ordinance of secession, and all acts of the confederate state government, and prohibiting the payment of any debts contracted by that government. These amendments were ratified by the people on Feb. 22. W. G. Brownlow was subsequently chosen governor, and members of the legislature were elected. Each voter at these elections was required to take an oath that he had been and would continue to be loyal to the United States. The legislature met in Nashville early in April, ratified the 13th amendment to the federal constitution, reorganized the state government, and elected senators to congress. Among the acts passed was one prescribing the qualifications of voters, which disfranchised those who had not been "publicly known to have entertained unconditional Union sentiments from the outbreak of the rebellion until the present time." The 14th amendment to the federal constitution was ratified in 1866, and the state was soon after admitted to representation in congress. The revision of the constitution by a convention sitting at Nashville from Jan. 10 to Feb. 22, 1870, was ratified on March 26 by a popular vote of 98,128 to 33,872.—See "The Geology of Tennessee," by Dr. J. M. Safford (1869), and "The Resources of Tennessee," prepared under the direction of the state board of agriculture by J. B. Killebrew (Nashville, 1874).

**TENNESSEE RIVER**, the largest tributary of the Ohio, formed by the union of the Clinch and Holston rivers, which rise in S. W. Virginia, and unite near Kingston, Roane co., Tenn. At first the course of the Tennessee is S. W. to Chattanooga, near the S. line of the state, where it passes through a part of the Cumberland range of mountains in a series of bends, and again turns S. W., entering the state of Alabama, and at Gunter's Landing, Marshall co., Ala., assumes a direction nearly W. by N. Between Lauderdale and Lawrence counties it spreads in a broad but shallow expansion called Muscle shoals, flowing over flint and limestone rocks in a succession of rapids for 36 m., and affording a large amount of water power. It afterward passes near Tuscumbia and Florence, on opposite sides, and at Chickasaw on the Mississippi line turns N. W., and forms the boundary thence to the Tennessee line between Alabama and Mississippi. Reëntering Tennessee, after a circuit of nearly 300 m. in Alabama, it flows almost due N. till it reaches Birmingham, Ky., when it turns W. N. W. and enters the Ohio at Paducah, McCracken co., 50 m. from the mouth of the latter. Its length from Kingston to Paducah is estimated at 800 m., but from the source of its longest affluent, the Holston, it is more than 1,100 m. Its principal tributaries are the Sequatchie,

Paint Rock, Flint, and Duck rivers, and Elk and Shoal creeks, entering it from the right; and the Hiawassee, Big Sandy, and Clark's rivers, and Town and Big Bear creeks, from the left. The fall of the river in its whole course is computed at about 2,000 ft. It is navigable from the Muscle shoals to the Ohio, 259 m.; above the shoals steamboats ascend to Knoxville, nearly 500 m. The scenery on the upper portion of the river is very beautiful. Darby estimates the area drained by the Tennessee and its tributaries at 41,000 sq. m.

**TENNIEL, John.** See p. 908.

**TENNIS,** a game of ball, played in a court built for the purpose, with a playing floor 112 by 40 ft., end walls 30 ft. high, side walls 20 ft. high, and usually lighted by skylights or windows above the 20-foot line. The players are two or four persons divided as partners on the "service" side and the "hazard" side. The ball is struck with a bat, called a racket, the striking part of which is covered with a close hard network of tendon. The player or party in strikes a ball, or "serves" it, against the head wall of the court. This ball must come to the ground over "the line," which is a network stretched across the middle of the court, 5 ft. high at each end and 3 ft. high in the middle. It is returned by the player or party out, who must in turn deliver it, by its rebound, at a certain place in the court, when it is again struck by the player in; and so the game continues. Whoever fails to "put the ball up" properly on the head wall, or to deliver it at the proper place on the court, loses. If it is the player in that fails, he loses his hand and goes out; if it is the player already out, his adversary scores a stroke toward game. There are several other contingencies which go to making the score, and the numerous angles caused by the walls constitute the intricacies of the game.—The name is from the French *tenez*, hold, as in striking the ball the racket must be held firmly. The game originated in France in the 15th century, and Louis XI., Henry II., and Charles IX. were expert players. M. Barre, who died in 1873, for many years superintendent of the tennis court in the Tuileries, was considered the best player that ever lived. The oldest English tennis court was built early in the 16th century in Hampton Court palace. There are two or three club courts in London, one at Leamington, and one at Brighton.

**TENNYSON, Alfred,** an English poet, born at Somersby, Lincolnshire, in 1809. His father was the Rev. George Clayton Tennyson, rector of Somersby and vicar of Bennington and Grimsby. His mother was a daughter of the Rev. Stephen Fytche, vicar of Louth. Alfred is the third of twelve children. He received his early education from his father, and was sent to Trinity college, Cambridge, where in 1829 he gained the chancellor's medal for a poem in blank verse entitled "Timbuctoo." In 1827, with his brother Charles (who has since become vicar of Grasby and assumed the name of Turner), he had published a small volume entitled "Poems, by Two Brothers." Coleridge expressed the opinion that only the pieces signed "C. T." gave promise of a coming poet. In 1830 Alfred published "Poems, chiefly Lyrical," in which the only striking piece was "Mariana;" but a revised and enlarged edition (1833) contained "The Lady of Shalott," "The May Queen," "Œnone," "A Dream of Fair Women," and "The Lotos-Eaters." This volume attracted comparatively little attention. In 1842 he published "English Idyls, and other Poems" (2 vols.), which contained all that he cared to preserve of the previous volume, and included also "Locksley Hall," "Morte d'Arthur," "The Talking Oak," "The Day-Dream," "The Two Voices," "St. Simeon Stylites," and "Ulysses." Tennyson's acknowledged rank as the first of living poets dates from the publication of these volumes. In 1847 he published "The Princess, a Medley," in blank verse, which has for its theme the question of the proper sphere of woman. The songs that form the interludes were introduced in the second edition. "In Memoriam," a series of 129 brief elegiac poems, suggested by the death of his friend Arthur Henry Hallam (see HALLAM), and written at intervals since 1833, appeared anonymously in 1850. On Nov. 21, 1850, after the death of Wordsworth, Tennyson was appointed poet laureate. His only notable performances in that capacity are the "Ode on the Death of the Duke of Wellington" and the "Charge of the Light Brigade at Balaklava," the popularity of each of which has been inversely as its merits. Both of these were included in the volume entitled "Maud, and other Poems" (1855). "Maud" was so anomalous, both in narrative treatment and metrical construction, that critics and readers were widely at variance concerning it; but there was no dissent from the applause which greeted the "Idyls of the King" (1859), four stories in blank verse, under the titles "Enid," "Vivien," "Elaine," and "Guinevere," drawn from the legends of King Arthur. These began a series which was continued in "The Holy Grail," "Gareth and Lynette," "Pelleas and Etarre," "The Last Tournament," and "The Passing of Arthur" (1869–'72). The whole epic had been foreshadowed in the prelude to the fragment entitled "Morte d'Arthur," which after 30 years found its place in the closing poem of the series. "Enoch Arden, and other Poems" (1864), included "Sea Dreams, an Idyl," for which Tennyson had received £10 a line on its original publication in "Macmillan's Magazine." With the exception of "Tithonus," "The Northern Farmer" (in dialect), and one or two other short pieces, the volume contained nothing worthy of the laureate; but the principal poem met with a wide popularity, and its title has become proverbial, from the supposed peculiarity of its

plot. "The Window, or the Songs of the Wrens," written for music by Arthur Sullivan, appeared in 1870, and "Queen Mary, a Drama," in 1875. Tennyson lived at various places, much of the time in London, till 1851, when he married Emily, daughter of Henry Sellwood, and settled at Farringford, Freshwater, Isle of Wight. In 1869 he removed to Petersfield, Hampshire. He has also a residence at Aldworth, Haslemere, Surrey, and is lord of the manors of Grasby and Prior's Freshwater. The university of Oxford conferred on him the degree of D. C. L. in 1859. Since 1850 his poems have been regularly reprinted in the United States, and two rival editions (New York and Boston, 1871) contain the suppressed pieces of his early volumes, and also some never collected by himself. His "Poems" have been translated into German by W. Herzberg (Dessau, 1854); "In Memoriam" by R. Waldmüller-Duboc (Hamburg, 2d ed., 1872) and Agnes von Bohlen (Berlin, 1874); and "Enoch Arden" by C. Hessel (Leipsic, 1874). "Enid" and "Elaine" have been translated into Spanish by Lope Gisbert (1875). His "Idyls of the King" have been illustrated by Doré. D. B. Brightwell has published a concordance to Tennyson's works (London, 1869).—See "Analysis of Tennyson's In Memoriam," by the Rev. F. W. Robertson (1867); "A Study of the Works of Alfred Tennyson," by E. C. Tanish (1868); and "Victorian Poets," by E. C. Stedman (1875).—FREDERICK, his elder brother, obtained at Cambridge a prize for a Greek poem in 1828, and in 1854 published "Days and Hours," a volume of poems.

**TENOR** (Lat. *tenere*, to hold), the second of the four parts in harmonic composition, reckoning from the bass, or the highest natural adult male voice, having a general compass from C, the second space in the bass, to A or B flat in the treble, though composers in chorus writing do not find it prudent often to write higher than G for this voice. The term is derived from the fact that in the ancient part compositions the tenor sustained or held the plain-song or principal air.

**TENSAS**, a N. E. parish of Louisiana, bordering on the Mississippi, and drained by Tensas river and Macon bayou; area, 680 sq. m.; pop. in 1875, 18,520, of whom 17,100 were colored. The surface is low and flat, and the soil fertile. It has steamboat communication with the interior by way of the Tensas river, which runs nearly parallel with the Mississippi, and joins the Washita in Catahoula parish to form Black river. The chief productions in 1870 were 94,500 bushels of Indian corn, 13,050 of sweet potatoes, and 25,371 bales of cotton. There were 1,211 horses, 2,404 mules and asses, 2,748 cattle, 1,043 sheep, and 2,684 swine. Capital, St. Joseph.

**TENT** (Lat. *tentorium*, from *tendere*, to stretch), a portable habitation, formed generally of cloth or skins stretched upon cords or frames, and supported by poles. Tents have always been the dwellings of nomadic tribes. The natives of the East brought them at an early period to a high state of perfection, and they are frequently mentioned in the Bible. The patriarchs were dwellers in tents, and St. Paul was a tent maker. Skins are first mentioned as a tent covering in Exodus xxvi. 14, where the tabernacle is ordered to be covered with rams' and badgers' skins. Tents of cloth made of camels' and goats' hair, like those of the Arabs of the present day, were also used. The Persian monarchs passed portions of the summer in tents in the mountains, and the custom of living in them during the hot months still prevails in the East. The Greeks encamped in tents at the siege of Troy, and the magnificence of the Persian tents and tent equipage is attested by many ancient writers. Tents were early used by the Roman armies, the first being made of skins or leather, and Hannibal's forces were provided with them when they crossed the Alps into Italy. The Roman *tabernaculum* resembled the house tent, and the *tentorium* the wedge tent of the present day.

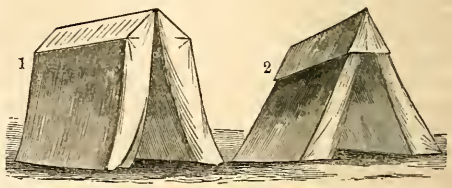


FIG. 1.—1. Roman Tabernaculum, from column of Trajan. 2. Tentorium, from column of Antonine.

A later and more elaborate tent was called *papilio;* it was probably circular, with a conical roof, but its exact form is not known. The armies of the crusades were provided with elaborate tents, and their Saracen antagonists were equally well furnished. Mediæval tents were sometimes of the most splendid description. The finest were very large, of the pavilion form, and divided into several apartments. Their hangings were frequently of silk and damask of many colors, and their cords and stay ropes of twisted gold.—Tents are said to have been first issued to modern armies by Louis XIV., but they were furnished only to certain privileged corps. According to Bardin, the Prussian army was the first regularly provided with them. Until near the middle of the 18th century there was little uniformity in their shape or quality. The earliest form in use in modern armies was probably the wedge tent, formed of a square piece of cloth over a ridge pole, and without stay ropes. A wedge tent rounded at one end and open at the other was called a *cannonière* in the French service in the last century. The *cortine* or *courtine* was an oblong wall tent, used by officers; when furnished with a fly or second roof, it was called a *marquise* or marquee. The use of tents in the French armies was almost abandoned after the begin-

ning of the revolution, and during the wars of the empire even the officers were rarely provided with them. It was not until about 1830, during the Algerian war, that the *tente abri* or shelter tent began to be regularly furnished to troops. This is made of two rectangular pieces of canvas, each 5 ft. 9 in. long and 5 ft. 4 in. wide, which are buttoned together and raised upon two sticks so as to form a roof open at both ends. Each soldier carries one of these pieces, one of the supporting sticks, and three pegs, which together weigh 3 lbs. 11 oz., and every two men are thus enabled to provide a shelter for themselves. This is still the French regulation tent, and was used in the Crimea, in Mexico, and in the Franco-German war. Besides this the French have three troop tents: the *bonnet de police*, which has the form of a triangular prism, to each end of which is joined a hemicone; the *tente elliptique* or Tacconet, a slight modification of the former; and the *tente conique* or *marabout*, a cone 22 ft. 4 in. in diameter at base and 10 ft. 8 in. high, with an interior curtain 14 in. high, which drops down around its base, leaving an interior diameter of 18 ft. 8 in. Each of these tents has two doors, opposite to each other. The French use also a marquee for general officers and a *tente de conseil*, the latter a round wall tent 20 ft. in diameter, with a conical roof. In the British service the use of tents was more generally adhered to after their introduction than in the continental armies. The troop tent principally used is the "bell" tent, a con-

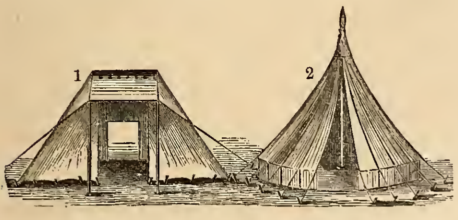



Fig. 2.—1. French Tente elliptique. 2. English Bell Tent.

ical-roofed round tent with a wall one or two feet high. Its diameter at the base is 14 ft. and its height 10 ft., and it is intended to shelter 12 to 15 men. The British have made but little use of shelter tents, although many models have been proposed. The Prussian troop tent is similar to the bell tent; but in the campaigns of 1866 and 1870 the German armies were not furnished with tents. In the Austrian service a "marching" tent is used, which resembles the French *bonnet de police*. It is 18 ft. long, 14 ft. wide, and about 7 ft. high, and accommodates 10 men. The Theurekauf troop tent is rectangular, and 26 ft. long by 22 ft. wide. It has a conical roof, with side walls 3 ft. high, and triangular end walls 7 ft. 6 in. high to the apex. An officers' tent, made after the same model, is also used. The Russian infantry tent is square, with a centre pole and four corner poles. It is 14 ft. in diameter and the side walls are 7 ft. high; it is intended for 14 men. The officers' tents are like those of the men, excepting that the roofs are of double canvas. The Italians use shelter tents, conical tents, and marquees. The shelter tent is formed of three rectangular sections, one of which is spread on the ground. The pieces are a little larger than those of the *tente abri*, and are supported by muskets instead of sticks. The conical tent, which is used by officers, is a modification of the French *tente conique.*

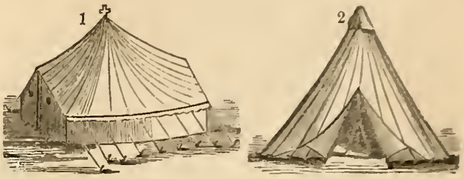



Fig. 3.—1. Theurekauf's Austrian Tent. 2. Sibley Tent.

A similar tent is in use in the Turkish army also, for both officers and men. In the United States the tents used most commonly have been the wedge, the Sibley, and the shelter. The wedge tent is 6 ft. 10 in. long, 8 ft. 4 in. wide, and 6 ft. 10 in. high; it is intended for five or six men. The Sibley tent is a modified Comanche lodge; it is a cone about 13 ft. high, with a diameter at base of 18 ft., and will shelter 12 or 14 men. During the last years of the civil war the shelter tent was used almost exclusively. The sections of the regulation tent are each 6 ft. long by 5 ft. 6 in. broad, and are made of cotton cloth with a coating of caoutchouc. Each section has a slit in it, through which the head may be passed, thus forming a poncho on the march, in rainy weather. It can also be used as a blanket. Shelter tents are sometimes formed in the American service into "half-faced camps," by fastening together two or three sections and stretching them from a ridge pole to the ground, thus making a back and roof. The triangular ends are then closed with other sections, and a fire built in the front, which is left open. This contrivance makes a very comfortable shelter, the heat which is reflected from the roof and sides keeping the men sufficiently warm.—The coverings of tents are now made generally of flax or cotton, hemp being rarely employed. The French tissue is of Belgian or Picardy flax, the English of the best long Baltic flax. The Austrian and the German canvas is also linen. The Italian government uses cotton canvas for large tents, and the Turkish government uses it altogether. In the United States army tents are made of cotton only, which is cheaper here than linen, while in Europe linen canvas can be produced at a lower price than cotton. The relative merits and demerits of the two tissues depend greatly on their mechanical structure and on

the quality of the materials used, but the weight of authority seems to favor cotton in preference to linen. In the beginning of the American civil war, when the price of cotton became excessive, the United States government purchased a large number of linen tents, but the troops objected to using them, and they were replaced by cotton ones.—*Hospital Tents.* In ancient times sick and wounded soldiers were treated in their general quarters. Tents specially set apart for the sick are said to have been first provided by Queen Isabella of Spain during the wars of Granada, but they did not come into general use. Invalids were occasionally treated in tents during the 17th and 18th centuries, but no organized tent hospitals, the records of which have any sanitary value, were established before the Crimean war. The enforced use of tents at Varna, made necessary by the absence of houses, first aroused attention to the subject of tent hospitals. The tent used was the hospital marquee of the British service, which is a double tent, a large one completely enveloping a smaller one, with an air space of about 18 in. between them. The inner tent is 28 ft. long, 15 ft. wide, and 12 ft. high in the middle, with walls 5 ft. high, and it has a floor cloth of painted canvas. It will accommodate 12 or 14 persons. The Prussian hospital tent, adopted in 1867, is house-shaped, double, supported by an iron frame, and large enough for 12 beds. In the Franco-German war a small square tent, supported by a light wooden frame and having a projecting pyramidal roof, was used. It was intended for but two beds, and was specially devoted to the treatment of those suffering from contagious diseases. The Turks have made use of a hospital tent which is described as of a long oval shape, supported by a pole at each end, and made of double canvas. The Russians, Austrians, and Italians have no special tent set apart for this purpose. The hospital tent used by the United

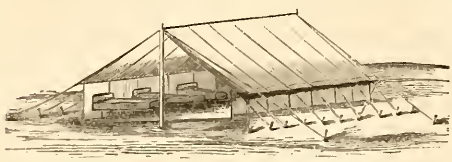


Fig. 4.—American Hospital Tent.

States government is a rectangular house tent, 14 by 15 ft. in diameter, and 11 ft. high in the centre, with a wall 4 ft. 6 in. high, and a fly forming a second roof which overlaps the wall about a foot. At one end it is furnished with a lapel so that two or more tents can be joined together to form one long tent. Each tent accommodates eight or ten patients.—See "The American Ambulance," by Dr. Thomas W. Evans (London, 1873).

**TENURE** (Lat. *tenere*, to hold), in its most general sense, the mode of holding property. In law it is usually confined to the manner of holding land or real property. The first grand division of tenures is into allodial tenures and feudal tenures. Of the word allodial, both the origin and the exact original meaning are uncertain. Practically it means a tenure which unites the right of the lord and the right of the tenant, or all right and title to or interest in the land. Hence, one who held land by allodial tenure had full and unencumbered possession of it, with an absolute right to use and dispose of it at his own pleasure, with no control of any one, and no responsibility to any one. An allodial holding stands in direct contrast with a feudal tenure, of which it was the essential quality that a tenant held it of a lord, and that tenant and lord had each their separate rights and interests in it and over it, or, in the language of the law, their separate estates in it. From this characteristic of allodial tenure, it is sometimes said that all the land in the United States is held by this tenure.—It seems to be generally admitted that previous to the prevalence of the feudal system the lands of European nations were held by allodial tenure, and that during the convulsions of the 9th, 10th, and 11th centuries, it became common for holders of land voluntarily to convert their allodial tenure into a feudal tenure, and so hold of some lord. One reason, and probably the strongest, was to obtain his support and protection in return for the allegiance of the tenant; but it may be believed that another cause of this change was the general desire to profit by the opportunity which the feudal system offered of escaping from the disordered and fragmentary condition of society then prevalent. This feudal system was nowhere more fully developed or more firmly established than in Normandy. It was therefore a matter of course that when William acquired England under a claim of title, but by the power of a feudal army which he carried with him, he should establish his victorious chiefs upon the land their arms had won under that feudal system which was admirably adapted to give to the sovereign lord, at any moment, a martial array that should combine nearly all the available force of the country, and be supported by all its available resources. He divided the land in unequal portions, observing that gradation of rank and of possession which constituted a characteristic feature of the system. While he who received a single manor became a baron and had his own court, they who received six or more were originally classed as greater barons; and to some of his principal chiefs he gave as many as 700 manors. In this way he divided most of the valuable land of England. His immediate successors followed the same system, and before a century had elapsed the feudal system and the feudal tenures were established over nearly all England. All these tenures rested upon the fee (see FEE); but they were very various, and divided the interest in and the beneficiary use of the land, between

the lord and the vassal, in very different proportions. There were generally many lords, for the system of subinfeudation prevailed, and the vassal held of his immediate lord, he of the next higher, and he of the next, the series always going up to and ending with the sovereign. Hence we may say that all tenure rested upon two principles: one, that all land was held of the sovereign, who retained certain rights and interests therein; the other, that all the rights and interests of all the lords, and of the tenant finally in possession, added together, constituted that allodial tenure already mentioned. There were various kinds of tenure, as for example tenure by copyhold, tenure in gavelkind, and the tenure of borough English. Of copyhold there is nothing in the United States. The principal feature of tenure in gavelkind was that all the sons inherited equally and together, instead of the eldest son alone, which latter is the rule of the feudal system, and is nearly universal in England. (See Gavelkind, and Heir.) Of tenure by borough English, the essential principle is, that neither the eldest nor all the sons inherit, but the youngest takes as heir. For this strange custom Littleton accounts by the lesser ability of the youngest son to take care of himself; but a custom prevalent in many parts of the United States offers a more probable explanation of this tenure. It is common in New England, for example, for the eldest son, as he comes to maturity, to receive what assistance his father can give, which is considered as his share of the estate; the same thing is done with other sons as they reach full age; until at length only the youngest son is left to take charge of his parents. When they die he has the homestead; or while they live they relinquish it to him, taking his obligation or trusting to his affection for support. The same custom is said to exist in Tyrol, Bavaria, and other parts of Germany.—The tenure with which we have most concern is that of socage. This was wholly liberated from the stringent military services which generally prevailed, and the civil services on which land was held under it were for the most part easy and honorable. At an early period it became known as "free and common socage," and as this tenure spread over England, the severities, restrictions, and encumbrances of the common feudal tenures passed away, until this process was completed by the statute 12 Charles II. (1661), and nearly all the old feudal tenures (all in fact which were in any way burdensome or restrictive of the proper rights of the tenant) were reduced to the tenure of free and common socage. This tenure has all the actual advantages of allodial ownership. The beneficial use which one who holds by this tenure has in the land comprises, for all practical purposes, a sole, undivided, and unencumbered interest. Escheat remains as a feudal incident to the tenure, but the lord cannot profit by it if the tenant has an heir or chooses to make a will. The tenant in fee simple of lands held in free and common socage can make any disposition of them, and carve any estates out of them, which the law of real estate permits; and any one to whom he grants it by sale or gift, or devises it by will, takes title directly from the grantor or testator, and his title is complete without the consent or concurrence of the lord or any action whatever on his part. It may be added that this tenure, unlike most other feudal tenures, has no reference whatever to the rank or occupation of the tenant, or to the purposes to which the lands are applied. This was the tenure created or prescribed by all the early colonial charters or patents from which our titles are now derived; as the charter of Virginia in 1606; the patent of New England in 1620; the charter of Massachusetts in 1629; of Maryland in 1632; of the province of Maine in 1639; of Connecticut in 1662; of Carolina in 1663; of Rhode Island in 1663; of Pennsylvania in 1681; the act of the general assembly of the colony of New York in 1691; and the charter of Georgia in 1732. But in New York, Pennsylvania, Connecticut, and Michigan all feudal tenures, including of course that of free and common socage, are abolished by statute; and it seems to be held, that under the provisions of the ordinance of 1787 the doctrine of tenures is not in force in any of the states formed out of the territory to which that ordinance applied. Substantially, our tenure unites what is best in both the allodial tenure and that by free and common socage. Nor is the fact without its historical value, that the allodial tenure, which formerly prevailed over all Europe, among all the nations who were the ancestors of European nations and so of our own, after being displaced for more than 1,000 years by the feudal system, is at length reëstablished in full force throughout the United States. And yet there are reasons for thinking the tenure of free and common socage, freed as it certainly is now from all feudal encumbrance, explains and illustrates our law of real estate better than the other theory. One reason is, that the principles of the feudal system do in fact underlie all the doctrines and all the forms of the common law in regard to real estate; and wherever the common law prevails, which it does in all the states excepting Louisiana (where the municipal law is founded upon the Roman civil law), the principles of the feudal law and of feudal tenure must be understood and made use of. Another reason is, that the law of escheat is universal with us (see Escheat), and it is governed by the law of feudal tenure, modified by our statutes. A third reason is, that the important and universal law of eminent domain is far better understood and applied by the theory that all property is held from the sovereign, that is, the state or people; and that in the original grant on which all title is founded, the sovereign reserved the right to resume the same for his own, that is,

for the public use, on making adequate compensation. Yet another reason is, that the obligation of fealty remains in full force. It is now and here an obligation only to the sovereign. It is implied, or rather it is expressed, in the oath of allegiance; but it does not depend on this oath. It is the obligation and the duty which rest on every citizen of the United States, as the condition upon which he holds all property, all interests, and all rights, to be "feall and loiall," as the old law expressed it, to be faithful and loyal to his sovereign, that is, to the state and to the Union.

**TEOCALLI.** See MEXICO, vol. xi., p. 474.

**TEOS,** an ancient Ionian city, on the W. coast of Asia Minor, about 25 m. S. W. of Smyrna. It is noted as the birthplace of Anacreon. It had two good harbors, and was a flourishing commercial town till the Persian conquest. The village of Sighajik, 1½ m. N. of Teos, has walls constructed from its ruins. The chief ruin is that of the temple of Bacchus.

**TEPLITZ,** or **Töplitz,** a watering place of N. Bohemia, in the circle of Leitmeritz, 45 m. N. W. of Prague; pop. in 1870, including the adjoining village of Schönau, 11,618. In the season of 1875 it was visited by about 30,000 invalids and tourists. Of the 17 alkalo-saline springs, 11 are now used, chiefly for the gout and rheumatism. A treaty of alliance between Russia, Prussia, and Austria, against Napoleon, was concluded here, Sept. 9, 1813.

**TEQUENDAMA, Falls of.** See BOGOTÁ.

**TERAMO. I.** A province of S. Italy, formerly Abruzzo Ulteriore I. (See ABRUZZO). **II.** A town, capital of the province (anc. *Interamna*), 85 m. N. E. of Rome; pop. about 19,000. It is the see of a bishop, and has a modernized Gothic cathedral, and manufactories of hats and cream of tartar. Interamna, which is also the ancient name of Terni and other places, was a city of Picenum. Many vestiges of the ancient city have been discovered on the site of Teramo.

**TERATOLOGY** (Gr. τέρας, a wonder or monster, and λόγος, discourse), that branch of physiological science which treats of the malformations and monstrosities of plants and animals. On account of its greater interest, more attention has been given to the latter, particularly within the present century, by French and German physiologists. There was no attempt to systematize the study of monstrosities till the time of Isidore Geoffroy Saint-Hilaire, who gave the science the above name. His classification is given in the article MONSTER. He divides the history of monstrosities into three periods, viz.: the fabulous, the positive, and the scientific. The fabulous period is all that prior to the 18th century; the positive embraces the first half of the 18th century; while the scientific dates from the middle of that century. In the fabulous period the prevalent belief attributed the formation of human monsters to divine anger as punishments to parents, or to demoniacal influence, and as the progeny of the devil they were destroyed. As late as the beginning of the 17th century it was said by learned men that children with six fingers were made in the image of the devil, and a remnant of such superstition still exists. The first important work was published by Leicetus in 1616, in which he gives a great collection of the most fabulous monsters. He quotes largely from a work on monsters by Lycosthenes (1557), and his pages abound in wonders. A work published by Haller in 1768 is the first which may be regarded as scientific. Buffon gives a classification of monsters in his "Natural History." Meckel, the celebrated physiologist, published a complete treatise on monsters in his *Handbuch der pathologischen Anatomie* (1812–'18), and Tiedemann makes important observations on the genesis of monsters in his *Anatomie der kopflosen Missgeburten* (1813). Works of the greatest importance were those of the two Geoffroy Saint-Hilaires (1822, 1829, and 1832–'6). A work on monsters in Dutch and Latin, by W. Vrolik, is one of the most complete manuals on teratology (Amsterdam, 1840–'42; new ed., fol., with 100 plates, 1849), and contains the most complete atlas that has ever been published. See also articles in the transactions of the New York state medical society for 1865, '66, '67, and '68, on "Diploteratology," by Dr. J. G. Fisher of Sing Sing, N. Y., giving a brief history of the subject of teratology, adding to the classification, and giving also the history of many cases of double monsters; J. North, "Lectures on Monstrosities" (London "Lancet," 1840); Allen Thompson, "Remarks upon the Early Condition and Probable Origin of Double Monsters," in "London and Edinburgh Monthly Journal of the Medical Sciences" (1844); J. Vogel, *Pathologische Anatomie des Menschlichen Körpers* (Leipsic, 1845); C. Rokitansky, *Lehrbuch der pathologischen Anatomie* (Vienna, 1851–'61); William F. Montgomery, "Account of a very remarkable Case of Double Monster," &c., in "Dublin Quarterly Journal of the Medical Sciences" (1853); A. Förster, *Die Missbildungen des Menschen* (2 vols. 4to, with 26 plates, Jena, 1861); and M. Lerboullet, *Recherches sur les monstruosités du brochet observées dans l'œuf, et sur leur mode de production*, in the *Annales des sciences naturelles* (Paris, 1863).

**TERBIUM,** a supposed metal discovered by Mosander in 1843, associated with erbium and yttrium in the mineral gadolinite. Very carefully conducted experiments of Bahr and Bunsen throw great doubt on the existence of terbium, and further experiments are required to afford a perfectly satisfactory answer to the question whether crude yttria is a mixture of three earths or of only two. According to Delafontaine, terbia is an earth of a pale rose color, the solutions of which exhibit an absorption spectrum, whereas the salts of erbia do not exhibit the same phenomenon by prismatic analysis. The metal terbium has never

been isolated, and a majority of chemists at present discredit its existence.

**TERBURG, Gerard,** a Dutch painter, born in Zwolle in 1608, died in Deventer in 1681. He painted cabinet size conversation pieces, musical parties, and ladies at their toilets. In 1648 he painted a picture of the plenipotentiaries assembled at the congress of Münster, which led to his being invited to Madrid by Philip IV. He excelled in color and the finishing of his draperies, especially white satin.

**TERCEIRA,** one of the Azore islands, near the centre of the group; lat. 38° 40′ N., lon. 27° 10′ W.; extreme length 20 m., general breadth about 12 m.; pop. about 50,000. The coast is generally bold and precipitous, and the central part of the island is mountainous, the summits consisting mostly of fertile plains. Many of the mountain masses are composed of soft pumice. The island is well watered, and the soil fertile. Grain, wine, and cattle are produced, and it exports oranges and lemons. Capital, Angra.—In 1829 Terceira became the seat of the regency for Dona Maria da Gloria during Dom Miguel's usurpation in Portugal, and Dom Pedro I. of Brazil collected there forces for the recovery of his daughter's throne.

**TEREDO.** See Ship Worm.

**TERENCE** (Publius Terentius Afer), a Roman comic poet, born in Carthage about 195 B. C., died about 159. He became a slave of P. Terentius Lucanus, a Roman senator, who gave him an excellent education, and finally freed him. The *Andria*, his first play, was acted in 166, and its success introduced him into the best society of Rome, Lælius and the younger Scipio being among his associates. Later in life he went to Greece, and there translated 108 of Menander's comedies. The manner of his death is uncertain, though the common account ascribes it to grief at the loss of all his translations of Menander. Six of his comedies are extant, and besides the *Andria* ("The Woman of Andros"), the plot of which was adopted by Steele in his "Conscious Lovers," there are *Hecyra* ("The Stepmother"), produced in 165; *Heauton - Timoroumenos* ("The Self-Tormentor"), produced in 163; *Eunuchus* ("The Eunuch"), the most popular of his plays, for which he received 8,000 sesterces, produced in 162; *Phormio*, produced in 162; and *Adelphi* ("The Brothers"), acted first in 160. The dramas of Terence all belong to the *fabula palliata*, and with the exception of the last two were first performed at the Megalesian games. The plots were borrowed from Menander. Terence's Latinity is elegant, and his works have been handed down in a very correct state. There have been numerous imitations of his comedies by the moderns, and they have been translated into nearly all the languages of Europe. The first edition is probably that of Milan (fol., 1470). Recent editions of the text with notes are those of Davies (London, 1869), Wagner (London, 1869), and Umpfenbach (Berlin, 1870). Among English translations are those of Colman (London, 1765), Patrick (Dublin, 1829), and Riley (London, 1853).

**TERHUNE, Mary Virginia** (Hawes), an American novelist, under the pseudonyme of Marion Harland, born in Amelia county, Va., about 1835. At the age of 16 she published in "Godey's Lady's Book" a sketch entitled "Marrying from Prudential Motives," which was copied into an English periodical, translated into French, retranslated into English, and published in England and America as an English tale. In 1856 she married the Rev. E. P. Terhune, and since 1859 has resided at Newark, N. J. Her works are: "Alone" (Richmond, 1854; 19th ed., 1856); "The Hidden Path" (New York, 1855); "Moss Side" (1857); "Miriam" and "Nemesis" (1860); "Husks" (1863); "Husbands and Homes" (1865); "Sunnybank" (1866); "The Christmas Holly" (1867); "Ruby's Husband" (1868); "Phemie's Temptation" (1869); "Helen Gardner," "The Empty Heart," "Common Sense in the Household, a Manual of Practical Housewifery," and "At Last" (1870); "True as Steel" (1872); "Jessamine" (1873); and "From my Youth Up" (1874).

**TERMINI-IMERESE** (anc. *Thermæ Himerenses*), a town of Sicily, part of the ancient northern Himera, in the province and 20 m. S. E. of the city of Palermo, E. of the mouth of the San Lionardo; pop. in 1872, 25,780. It has fine churches, a good harbor, fisheries, and an active trade in local products, including maccaroni, which is the best in Sicily.—After the destruction of the Greek city of Himera by Hannibal, the son of Gisco, in 409 B. C., the surviving inhabitants fled to the neighboring Thermæ, so named from its celebrated hot sulphur springs. The town appears to have existed during the Roman empire, and considerable portions of the Roman part are still visible. The southern Thermæ or Thermæ Selinuntiæ is described under Sciacca, its modern site. (See also Himera.)

**TERMITES,** the proper name of the white ants, or the neuropterous insects of the family *termitinæ*. Though they resemble the common ants (*formica*) in their social habits, they belong to a different order, and in many respects come near the orthoptera. In the genus *termes* (Linn.) the antennæ are thread-shaped, with about 20 joints; the eyes small but prominent, and the ocelli three; the mouth as in orthoptera; thorax distinct, and wings large, long, and membranous; legs short with four-jointed tarsi; abdomen with a pair of minute caudal appendages. They live in vast communities, principally in the tropics, and do great damage by devouring everything but metals and stone which comes in their way, gnawing even the interior of the beams of houses, leaving only a thin shell. According to Latreille there are five classes in their communities, males, females, workers, neuters, and soldiers. The males and females are at first

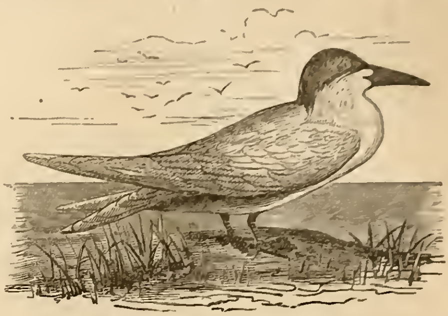
exactly alike, and are furnished with four very long, nearly equal wings; after impregnation the abdomen increases greatly from the immense number of eggs which it contains; as many as 80,000 may be laid by one female in 24 hours, making about 30,000,000 in a year. Most of the community is made up of wingless individuals, resembling the winged insects, but without eyes; these are the workers, which perform all the labors of construction. Others without wings, apparently pupæ, resemble the workers, but have four tubercular wing cases on the thorax; these are supposed to be neuters or incomplete females, which attend upon the king and queen and take care of the young brood; the extraordinary fecundity of these ants renders necessary a large class of neuters, which possess the affections of maternity without the power of reproduction. The fifth class, apparently neuters still further developed, have very large jaws, and are the soldiers and defenders of the rest. From the researches of Fritz Müller ("Nature," 1874) it appears that, unlike the social hymenoptera, the neuters of the termites are not sterile females, but modified larvæ which undergo no further metamorphosis; that both sexes are represented among the neuters; and that there are in many (if not in all) species two forms of sexual individuals, winged and wingless males and females; the former produced in vast numbers, leaving the nest, and most of them perishing; the latter never leaving the termitary where they were born. The constitution of their societies in its general characteristics does not vary essentially from that noticed under ANT. They make edifices of a most remarkable size and complexity, usually on the ground, but sometimes among branches of trees and in houses, communicating with the ground by long spiral galleries. When on the ground, the most usual shape is that of a group of irregular cones, frequently 12 ft. high, looking like huts of the natives, and so firmly constructed that man and beast can stand on them securely; they are built of earth softened in the jaws of the workers, which dries quickly and becomes very hard. A nest is divided internally into numerous chambers and galleries, in one of which the queen is imprisoned, and waited upon by numerous special attendants whose apartments are in close proximity to the royal cell; the male is said to lie concealed under one side of the enlarged abdomen of the female. The attendants carry off the eggs as soon as they are laid into separate chambers, where the young when hatched are tended by the nurses. There are generally two or three roofs within the dome-shaped interior, and the thick walls are perforated by passages leading in various directions to the nurseries, magazines of food, ground floor, and subterranean entrances; the food consists principally of decaying and dried wood, though gums and thickened vegetable juices are stored in their magazines. The king and queen have no regal authority. Destructive as the termites often are, they play a most important part in the economy of nature by removing decaying wood, which otherwise in a short time would seriously interfere with vegetation in the tropics.—The largest and best known species is the warrior white ant of Africa (*T. fatalis*, Linn., or *T. bellicosus*, Smeath.); in each nest there are a king and queen, and about 100 workers to one soldier; the workers are about a quarter of an inch long, always busy and very fast runners; the soldiers, which appear to be the same further developed, are about half an inch long, and the perfect insects from $\frac{6}{10}$ to $\frac{7}{10}$ of an inch long; it is supposed


Nest of the White Ant (Termes bellicosus).
1. Male. 2. Gravid female. 3, 4, 5. Neuters.

that two or three years are requisite for the full development of the species from the egg. Toward the commencement of the rainy season the perfect insects take flight, but are mostly destroyed by the heavy rains; if a pair escape, they are taken by some of the workers which are always running over the ground, and are made the king and queen of a new colony. The pregnant female has the abdomen 3 to 5 in. long and two thirds of an inch wide, about 2,000 times as large as the rest of her body, and 20,000 to 30,000 times as large as that of the workers. The bite of the soldiers is very severe and painful, but not dangerous to a healthy person; they permit themselves to be torn asunder rather than let go their hold. They have many enemies in other ants, birds, and reptiles, which destroy great numbers; the wingless ones are also devoured with avid-

ity by the natives and even by Europeans, who roast them in the manner of coffee. (See "Insect Architecture," by James Rennie, in the "Library of Entertaining Knowledge," London, 1830-'31).—There are other species in tropical Asia, and even two or three in southern Europe. In the United States a representative species, the *T. frontalis* (Haldeman), has been noticed at Salem, Mass., where it did considerable mischief in greenhouses and graperies, not only attacking decaying and dead wood, but also excavating the roots of living vines and causing their destruction. (See "Proceedings of the Boston Society of Natural History," vol. vii., pp. 287, 288, May 2, 1860.)

**TERN,** the proper name of the birds of the gull family and subfamily *sterninæ*, among which is included the noddy, previously described. The terns have a rather long, usually slender, nearly straight, and sharp-pointed bill; wings elongated, with long and pointed primaries; tail long, and in most species forked; tarsi slender, anterior toes with a deeply notched web, hind toe small, and the claws curved and sharp. They are found on and near the sea shore, and sometimes on inland lakes and rivers, most of the time hovering with rapid and easy flight over sandy bars and shallows, darting suddenly upon small fishes and crustaceans; they are often seen swimming and resting on the water, but never diving; from their forked tail, small size, and swift and graceful flight, they are popularly called sea swallows.—In the typical genus *sterna* (Linn.) the upper mandible is slightly curved, with the frontal feathers extending to the nostrils; the outer quill is the longest. It contains more than 60 species, in both hemispheres, migrating in bands from place to place according to season; the eggs are two to four, usually deposited in a slight hollow in the sand on rocks surrounded by the sea; the hatching is left mostly to the sun, the females sitting only at night and in cold weather; the young are carefully fed and bravely defended. The largest species is the Caspian tern (*S. Caspia*, Pall.), 21½ in. long, 51 in. in alar extent, with a very stout bill of 3 in.; the back and wings are pale bluish ash, the upper parts of the head black with a greenish gloss, the quill shafts and the under plumage pure white, the bill vermilion, and the legs and feet black; the tail is not much forked; the young are mottled above with blackish brown. It is found in the United States from the coast of New Jersey northward, and all over Europe, in the vicinity of the Caspian sea (where it was first found and described by Pallas), and also in Africa. The eggs, as in most of the terns, are yellowish stone-colored, with ash-gray and dark reddish brown spots; they are 2½ by 1⅔ in. The Cayenne or royal tern (*S. Cayana*, Bonap.) is 21 in. long and 49 in. in alar extent, with a deep red bill of 2¾ in.; the mantle is bluish gray, lower parts white, legs and feet black, and the tail forked. It is found on the Atlantic coast from Labrador to Florida, being abundant about the southern keys; it also occurs in California. It is very shy, and utters loud and harsh cries during flight; when any are killed



Cayenne Tern (Sterna Cayana).

out of a flock, the rest dart toward the gunner; when wounded they eject the contents of the stomach, and bite severely; the eggs are 2¾ by 1¾ in., and like those of the other species afford good eating; the flesh is very oily. The sooty tern (*S. fuliginosa*, Gmel.) is 16½ in. long and 35 in. in alar extent; bill 1¾ in. and black, as are the legs and feet; it is deep black above, the forehead and lower parts white; tail deeply forked, black, with the outer and basal half of the inner web of the outside feathers white. It is found in the gulf states from Texas to Florida, arriving from the south in May and departing by the beginning of August; it rarely alights on the water, where it would be incommoded by its long tail; it feeds principally on fish, which it seizes by a sweeping curve; the cries are very loud when the breeding places are disturbed; the eggs are three in number, 2¼ by 1½ in., and in former times were the source of a considerable trade with Havana. Wilson's tern (*S. Wilsoni*, Bonap.) is 15 in. long, with an alar extent of 32 in.; the bill is 1⅝ in., slender, coral red, black near the end with a yellow tip; mantle light grayish blue; upper part of head and neck deep black; beneath pearl-gray; tail deeply forked, with the outer web of lateral feather blackish gray; legs and feet coral red. It is found from Texas to Labrador, and on the coast of Massachusetts goes by the name of mackerel gull, from the supposition that it announces the arrival of this fish in its summer quarters; it formerly bred on Egg Rock near Nahant, and was very abundant in summer on Nantasket beach; the eggs are three, 1¾ by 1¼ in. Its European representative is the common sea swallow (*S. hirundo*, Linn.), spread over Europe and Africa; it is 14¼ in. long, and the eggs 1⅝ by 1⅛ in. The arctic tern (*S. macrura*, Naum.) is 14½ in. long, and 32 in. in extent of wings; the bill 1⅛ in., slender, and deep carmine; mantle light grayish blue, and under parts plumbeous gray; tail very deeply forked; legs and feet crimson. It is found from the coast of New England to the arctic seas and the fur countries, also

coming down to N. Europe; it is a very rapid and graceful flier, dashing boldly into the water after fish and shrimps; the eggs are delicious, 1¼ by ⅝ in. There are several other species, and another genus, the short-tailed or black tern, *hydrochelidon* (Boie), with the species *H. plumbea* in America and *H. nigra* in Europe.

**TERNATE.** See MOLUCCAS.

**TERNAUX. I. Guillaume Louis,** baron, a French manufacturer, born in Sedan, Oct. 8, 1763, died in St. Ouen, April 2, 1833. When scarcely 16 years old he managed his father's woollen factory, and retrieved the fortune of his family. He was a supporter of reform in 1789, but was one of the king's defenders in 1792. After the fall of Robespierre he established large manufactories at Louviers and Sedan. He naturalized Thibetan goats in France, and manufactured shawls in imitation of the Indian ones, known as *cachemires-Ternaux.* He was made a baron by Louis XVIII.; in 1818 he was elected a deputy; was reëlected in 1827, and was one of the 221 deputies whose decided stand against the government brought about the revolution of July, 1830. The commercial crisis which followed ruined him, though he paid all his debts. He published several treatises on finance and manufactures. **II. Henri,** nephew of the preceding, known as Henri Ternaux-Campans, born in Paris in 1807, died there in 1864. He was distinguished for his devotion to the study of American history, and published two series, in 10 vols. each, of *Voyages, relations et mémoires*, from inedited Spanish manuscripts, relating to the discovery and conquest of America (Paris, 1836–'40); *Bibliothèque américaine*, 1493–1700 (8vo, 1837); *Bibliothèque asiatique et africaine* (1841–'2); and various other works.—MORTIMER, his brother, born in Paris in 1808, has published *La chute de la royauté*, 10 *août* 1792 (1864); *Le peuple aux Tuileries*, 20 *juin* 1792 (1864); and *Histoire de la terreur* (1792–'4), from inedited documents (7 vols. 8vo, 1862–'9).

**TERNI** (anc. *Interamna*), a town of Italy, in the province of Perugia, on an island formed by the Nera, 49 m. N. by E. of Rome; pop. about 10,000. It has a cathedral built from the designs of Bernini, with a high altar rich in marbles; and there are many Roman remains and inscriptions. Silk and oil are the chief articles of trade. About 5 m. from Terni are the celebrated falls of the Velino (*cadute delle Marmore*), about 800 ft. high, fed by an artificial channel laid out by the Romans to drain the plains of Rieti. The water descends by three separate leaps, respectively 50, 500, and 250 ft. high, forming one continuous sheet of foam, described by Byron "as worth all the cascades and torrents of Switzerland put together."—The ancient Interamna, originally belonging to Umbria, was celebrated under the Romans, as Terni still is, for the remarkable fertility of the surrounding country.

**TERPANDER** (Τέρπανδρος), a Greek musician, born at Antissa in the island of Lesbos, flourished in the earlier half of the 7th century B. C. He removed to Sparta, where in 676 he was crowned victor in the first musical contest at the feast of Apollo Carneius, and where he established the first musical school or system in Greece. He enlarged the compass of the lyre from a tetrachord to an octave, but with the omission of the third string, counting from the highest down, making it really a heptachord; and he was the first who regularly set poetry to music.

**TERPSICHORE,** one of the nine Muses, daughter of Jupiter and Mnemosyne. She presided over choral song and dancing, and is generally represented as crowned with flowers and holding a lyre and plectrum.

**TERRA,** or **Tellus,** a goddess of the Roman mythology, in whose form the earth was personified and worshipped, and who is thus often named in contrast with Jupiter, the god of heaven. A festival in her honor was celebrated on the 15th of April, and private sacrifices were offered to her at seedtime and harvest, and also when any member of a family died. Terra corresponds to Gæa or Ge in Greek mythology. In the Hesiodic theogony Gæa was the first born of Chaos. She gave birth to Uranus, whom she afterward married, and from this union sprang the Titans, the Cyclops, and the hundred-handed giants. Her worship was universal among the Greeks.

**TERRACINA,** a town of Italy, in the province of Rome, on a gulf of its own name in the Mediterranean, at the S. W. end of the Pontine marshes, 26 m. S. W. of Frosinone; pop. about 5,000. It has a cathedral occupying, according to some authorities, the site of the celebrated ancient temple of Jupiter Anxur, from which its beautiful fluted marble columns are said to have been taken. The most picturesque of the many ruins are those of the palace of Theodoric, on the summit of the hill above the town. Near the shore is a palace built by Pius VI., who made considerable but not successful efforts to drain the marshes and to restore the ancient port, which is still filled with sand, though a new pier affords protection to small craft. The bishopric of Terracina is said to date from A. D. 46.—Terracina was the Anxur of the Volscians and the Romans; the latter had fine villas and a naval station here, and also called the place Tarracina.

**TERRA COTTA** (It., baked clay), an earthenware employed by the ancient Greeks and Egyptians in the manufacture of moulds, architectural ornaments, statuary, utensils, sarcophagi, and various other objects. An important use of it among the Assyrians and Babylonians was for the preservation of records, which were stamped upon terra cotta slabs and cylinders. The material is clay of considerable purity, and the articles are generally slack-baked, or merely hardened by continued exposure to the sun. The color is usually a red or buff, and the vases are often ornamented with designs of leaves, vines, &c., painted

in black or other colors. While these adorn the rim, neck, and stand, the body is sometimes covered with allegorical representations of gods, men, and animals. The Romans employed finer materials for their terra cottas, and moulded these into lamps, urns, &c., which they ornamented with depressed or raised figures. From the 12th to the 17th century terra cotta was much used in Italy for architectural decorations, and Michel Angelo and other sculptors employed it for their models and clay sketches. The manufacture of decorative works in terra cotta has been an important branch of industry in England since the latter part of the 18th century. The mixtures employed are of pure clays and fine quartz sand or calcined flints with pulverized potsherds or old pottery. The coats of arms seen over many of the shop fronts in London are moulded and baked in this material. It is also used for statues, baptismal fonts, fountains, and ornamental pieces of various forms in different parts of buildings. The ware is much more firmly baked than that of the ancients. Of late years it has been extensively employed for elaborate architectural ornaments, such as are ordinarily carved in stone, and also for architectural models. Drain tiles and similar ware are made of it. It is also an important manufacture in France, and there was a remarkable display of terra cotta statues and other objects in the Paris exhibition of 1867.

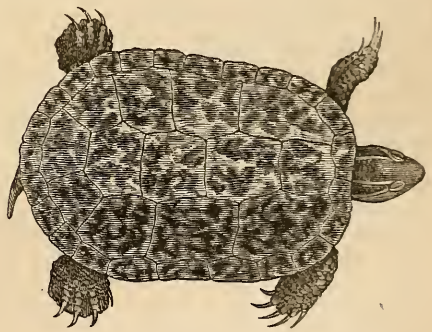
**TERRA DEL FUEGO.** See Tierra Del Fuego.

**TERRA DI BARI.** See Bari.

**TERRA DI LAVORO.** See Caserta.

**TERRA D'OTRANTO.** See Lecce.

**TERRAPIN,** a name commonly applied to several species of land tortoises, but in the United States generally limited to the few freshwater species of the family *emydoidæ*, extensively used as food. They have a depressed head, and the neck can be wholly retracted within the shell; eyes large, and the beak somewhat like that of a bird of prey; they are good swimmers, and out of the water move with more quickness than the land tortoises; their food consists of small reptiles, fish, and other aquatic animals, though in captivity they eat vegetables readily.—The yellow-bellied terrapin (*trachemys scabra*, Ag.; *emys serrata*, Daud.) is 12 in. long, 7½ in. wide, and about 11 in. high; the shell is rounded, very convex, notched in front, deeply serrated behind, wrinkled longitudinally, and rough all over. The color is blackish brown with yellow lines and marks more or less radiating; sternum yellowish, notched behind; snout short and pointed; upper jaw with a very slight notch; eyes large, with golden iris having a broad black stripe extending horizontally through it; fingers five, each with a short strong nail, and toes five, fully webbed, four only having nails; tail short, thick, and pointed; head and limbs black, varied with yellow lines, a broad transverse band of the latter across the neck behind the eyes. This species lives in stagnant ponds and pools, and is fond of basking in the sun on the margins and on stones and stumps, whence it can readily plunge into the water if disturbed; it is found from Virginia to Georgia, south of the latter being replaced by the Florida and north of the former by the red-bellied terrapin; it is abundant about Charleston, S. C., where it is seen in great numbers in the markets.—The red-bellied terrapin, or potter (*ptychemys rugosa*, Ag.; *E. rubriventris*, Le Conte), is 11 in. long, 7 in. wide, and about 5 in. high; the shell is entire in front, widest and notched behind; upper jaw deeply notched, and the lower serrated with three teeth in front; shell, head, neck, and limbs dusky brown, with blotches, spots, and lines of red; sternum dusky red. It lives in running waters, preferring rocky bottom; it is found between the Delaware river and Chesapeake bay, and is abundant about Trenton, N. J.; its flesh is less esteemed than that of the preceding and following species.—The Florida terrapin (*P. concinna*, Ag.; *E. Floridana*, Harlan) is the largest of the species, being 15 in. long, 10 in. wide, and 7¼ in. high; the shell is entire, compressed on the sides;



Red-bellied Terrapin (Ptychemys rugosa).

the jaws without teeth, the lower somewhat serrated; the shell, neck, head, and limbs brownish, with numerous yellow lines and bands; sternum pale yellow, the marginal plates with a black spot having a yellow centre; throat ashy, striped with yellow. It is extensively distributed through the southern states, in lakes and rivers, from North Carolina as far as western Louisiana, and up the Mississippi valley to Arkansas; it is very common in E. Florida, especially in the St. John's river; its flesh is delicious.—The chicken terrapin (*deirochelys reticulata*, Ag.; *E. reticulata*, Schweig.) is 9½ in. long and 5½ in. wide; the shell is oval, entire, longitudinally rough; upper jaw slightly notched, lower entire with a hook in front; neck very long; above, head, neck, and limbs dark brown, with numerous yellow lines communicating so as to form a network, whence the specific name; lower parts yellow, with black spots on some of the marginal plates. Its habits are the same as in the other species, the long neck giving it

in the water somewhat the appearance of a snake, as it swims with this part and the head alone visible above the surface. It is found from North Carolina and Georgia to Louisiana, not far from the sea coast; it is often brought to market, and is the most esteemed of the terrapins for food.—The salt-water terrapin (*malacoclemmys palustris*, Ag.; *E. terrapin*, Holbr.) is 7½ in. long and 3 in. high; the shell is nearly entire, slightly notched posteriorly; the head is very large; jaws strong and cutting, the upper slightly notched and the lower hooked; eyes small with a gray iris; neck short and thick. The color is dusky olive-green, with darker concentric lines; sternum generally yellowish with concentric dusky lines; side of the head, neck, and limbs brownish white with innumerable black dots; the males are the smaller, and have deeper striæ. It lives in salt water and in salt marshes, where it hibernates; it is very shy, a rapid swimmer, and a quick runner on land; it is found from Rhode Island to Florida, along the gulf of Mexico, in South America, and perhaps in the West Indies; it is abundant about Charleston, S. C.; the flesh is excellent, and in the middle states most esteemed during hibernation.

**TERRE BONNE**, a S. E. parish of Louisiana, bordering on the gulf of Mexico, and drained by the Terre Bonne, Black, and Caillou bayous; area, 1,640 sq. m.; pop. in 1875, 15,486, of whom 7,988 were colored. The surface is flat and marshy, and diversified by numerous shallow lakes. Morgan's Louisiana and Texas railroad intersects the N. part. The chief productions in 1870 were 209,050 bushels of Indian corn, 233,000 lbs. of rice, 130 bales of cotton, 6,537 hogsheads of sugar, and 366,282 gallons of molasses. There were 676 horses, 1,798 mules and asses, 696 milch cows, 1,357 other cattle, and 2,426 swine; 4 saw mills, 64 manufactories of molasses and sugar, and 4 of upholstery. Capital, Houma.

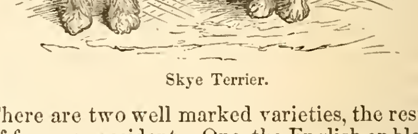
**TERREBONNE**, a S. W. county of Quebec, Canada, on the N. bank of the St. Lawrence, opposite Montreal; area, 541 sq. m.; pop. in 1871, 19,591, of whom 18,151 were of French and 970 of Irish origin or descent. It is drained by the North river, an affluent of the Ottawa, and by several streams that empty into the St. Lawrence. Capital, St. Jerome.

**TERRE HAUTE**, a city and the capital of Vigo co., Indiana, on the E. bank of the Wabash river, here spanned by three bridges, 70 m. W. S. W. of Indianapolis, and 55 m. N. of Vincennes; pop. in 1850, 4,051; in 1860, 8,594; in 1870, 16,103. It is situated on an elevated plateau, is well built, and has broad streets ornamented with shade trees. It is the centre of trade for a rich and populous region, abounding in coal. It is connected with Lake Erie by the Wabash and Erie canal. The Wabash river is navigable a portion of the year for steamboats, and shipments are made direct to and from points on the Ohio and Mississippi rivers. The city is an important railroad centre, being the point of intersection of seven lines, viz.: the Cincinnati and Terre Haute; Evansville, Terre Haute, and Chicago; Terre Haute, Paris, and Decatur; Evansville and Crawfordsville; Indianapolis and St. Louis; St. Louis, Vandalia, Terre Haute, and Indianapolis; and Logansport, Crawfordsville, and Southwestern. There are numerous large factories, blast furnaces, glass and iron works, machine shops, nail works, &c. Pork packing is extensively carried on. Terre Haute has a handsome court house, a commodious market house and city hall, a good opera house, two orphan asylums, eight fine public school buildings, and several private schools and academies, and is the seat of the state normal school. There are three daily, a tri-weekly (German), and six weekly (one German) newspapers, two public libraries, and 20 churches. Terre Haute was laid out in 1816, and incorporated as a city in 1853.

**TERRELL**, a S. W. county of Georgia, drained by affluents of Flint river; area, about 300 sq. m.; pop. in 1870, 9,053, of whom 5,284 were colored. The surface is nearly level. The Southwestern railroad traverses it. The chief productions in 1870 were 158,130 bushels of Indian corn, 13,973 of oats, 22,898 of sweet potatoes, and 6,163 bales of cotton. There were 444 horses, 983 mules and asses, 982 milch cows, 2,083 other cattle, 1,069 sheep, and 6,742 swine; several manufactories, 6 saw mills, and 1 tannery. Capital, Dawson.

**TERRESTRIAL MAGNETISM.** See MAGNETISM, TERRESTRIAL.

**TERRIER** (*canis terrarius*, Flem.), a small variety of dog, so named from its propensity to pursue and attack its prey in subterranean retreats. It is considered by Hamilton Smith as descended from an indigenous European canine.



Skye Terrier.

There are two well marked varieties, the result of fancy or accident. One, the English or black and tan, is smooth, rounded, elegant in shape, usually black, with tan-colored spots over the eyes and the same tint on the legs and lower parts; the nose is sharp, eyes bright, ears pointed or slightly turned down, and the tail carried high and bowed over the back. The other, the Scotch terrier, the oldest and purest breed, has shaggy and wiry hair, a shorter and fuller muzzle, bearded snout and face, stouter limbs, less elegant form, and a pale sandy or

ochrey color; it is sometimes white. The isle of Skye breed is one of the most prized, and one of the ugliest. The terrier has an acute sense of smell, and is a good attendant on a pack of hounds, forcing foxes and other game from their coverts and dens; it is a determined enemy of the weasel, badger, and rat families. The jaws are very powerful. The Scotch terrier has been known to kill 100 rats in a room in less than seven minutes. In England the terrier blood is visible in most of the sheep and cattle dogs; but the most prized variety is the bull terrier, from a cross with the bulldog, the most determined, pugnacious, and savage of the dog tribe; in this the ears are pointed, and the general characters are those of the bulldog; it is usually white, with some black about the head.—The turnspit is a cross of the terrier with larger and less pure breeds; the body is long and heavy, with disproportionately short and generally crooked legs; it is bold, vigilant, and spirited, and, though larger, is used in Europe for the purposes of the terrier; it is, when best, a cross with a hound; it received its name from its being in old times employed to turn the spit in the kitchen, walking round in a kind of wheel. The *C. vertagus* of the ancients, sometimes erroneously translated turnspit, is the lurcher, a degenerate greyhound.

**TERTIARIANS** (Fr. *tierciare*, from Lat. *tertiarius*, containing a third part), men or women belonging to the "third order" in any one of the monastic orders. The tertiarians, without living in cloistered communities, bind themselves by simple vows to certain prayers and observances of the order. Such an organization of secular persons occurs for the first time in the history of the Premonstratensians, and another was connected with the order of the Templars. But it did not become generally known until Francis of Assisi, after founding the order of the Franciscans (the first order) and the order of the Poor Clares (second order), founded a third one for the numerous laymen who wished to conform themselves to the mode of life of the Franciscans as much as secular occupations would permit. When their number increased, many of them resolved to adopt the common life, and thus the third regular order of Franciscans arose. (See FRANCISCANS, vol. vii., p. 425.) The example of the Franciscans was followed by the Dominicans, Augustinians, Carmelites, Servites, and other orders, all which have connected with them both tertiarians living in the world, and regular tertiarians living in common.

**TERTULLIAN** (QUINTUS SEPTIMIUS FLORENS TERTULLIANUS), one of the early church fathers, born in Carthage about A. D. 150, died between 220 and 240. He was the son of a Roman centurion, became a lawyer, embraced Christianity about 190, and entered the Christian priesthood. He preached at Carthage and probably at Rome, and became widely known by the publication of several controversial treatises, as well as his ascetic practices. About the year 202 he joined the Montanists, and at once became the champion of the sect, with which he remained until his death. The difference between his works written before and those after he became a Montanist seems to be more a difference of spirit than of doctrine; and his writings are classed in authority with those of the other church fathers. He was the fearless champion of Christianity against Jews and pagans, and of catholic orthodoxy in the church. His *Apologeticus* has been called the first plea for religious liberty in Christian literature, and is one of the best defences of Christianity and the Christians against their pagan adversaries. In his treatise "On the Testimony of the Soul" he unfolds the profound thought that Christianity is grounded in the nature of man, and meets its deepest wants. He led the way in ecclesiastical anthropology and soteriology, was the teacher of Cyprian, and the forerunner of Augustine. Among his controversial works are his books "Against the Gentiles," "Against the Jews," "Against Hermogenes" (showing that matter is not eternal, but created by God), "Against the Valentinians," "On the Prescription of Heretics" (asserting vehemently that no doctrine contrary to the received faith had a claim to toleration from the church, or to appeal to the Scriptures, and contradicting the principles of his "Apology"), "Against Marcion," "Against Praxeas," "On the Soul," "On Baptism," "On the Flesh of Christ," and "On the Resurrection of the Body," in all of which he opposes growing errors, and seeks to show what is the true doctrine of the church. Among his practical works belong the book "On Penance;" that "On Prayer," which explains the Lord's prayer; "On Patience;" "To the Martyrs;" "On Theatrical Shows;" "On Idolatry," a casuistical discussion of the degree to which idol worship may be tolerated by Christians; "On the Dress of Women," and on the "Veiling of Virgins," which teach that modesty and the hiding of the features are proper for women in the house of God; and the book "To his Wife," in which he proclaims his aversion to second marriages. His specially Montanist works are the "Exhortation to Chastity" and "On Monogamy," in which he carries to absolute prohibition the theory of the book "To his Wife;" "On Chastity," which denies that those who are guilty of gross sins can be absolved; "On Repentance;" "On Fasting;" "On the Soldier's Crown;" and "On Flight," which insists that Christians ought not to flee from persecutions. Tertullian's works are written in a rude Punic Latin interlarded with African or old Latin idioms and phrases of Latinized Greek. His earlier works are said to have been written in Greek, but have come down only in Latin translations. The style of all is nervous, abrupt, often obscure, and vehement. The first collected edition is that by Beatus Rhenanus (fol., Basel, 1521). Among the numerous later editions are those by Semler (6 vols., Halle, 1770–'73), Leo-

pold in Gersdorf's *Bibliotheca Patrum Latinorum* (vols. iv. to vii., Leipsic, 1839–'41), Migne (vols. i. to iii. of *Patrologie latine*, Paris, 1844), and Oehler (3 vols., Leipsic, 1853). Translations of several, especially of the "Apology," have been published in most of the modern European languages.—The life of Tertullian has been written by Jerome in the early church, and in modern times by Neander (*Antignosticus*, Berlin, 1825) and Hesselberg (Dorpat, 1848). See also the special works on Montanism by Wernsdorf (1751), Münter (1829), Schwegler (1841), and Baur (1851).

**TERUEL. I.** A N. E. province of Spain, in Aragon, bordering on Saragossa, Tarragona, Castellon, Valencia, Cuenca, and Guadalajara; area, 5,494 sq. m.; pop. in 1870, 252,201. The Albarracin mountains traverse it E. and W., sending off numerous spurs on both sides, which are covered with forests and abound in game. Muela de San Juan, one of the principal summits of the main range, is covered with snow during the greater part of the year, and the rivers Tagus, Guadalaviar, and Jucar have their sources on its sides. The province is well watered by the Guadalupe and the Jiloca, affluents of the Ebro, the Guadalaviar, and numerous smaller streams. There are extensive plains producing grain, wine, oil, silk, hemp, flax, saffron, and fruit. Numerous sheep, swine, and cattle are reared. Coarse woollen goods, linen, canvas, leather, paper, and earthenware are manufactured. **II.** A town, capital of the province, on the left bank of the Guadalaviar, 136 m. E. of Madrid; pop. about 10,500. It stands on elevated ground, is surrounded by old walls, and entered by a number of gates surmounted by Aragonese towers. There is a cathedral, episcopal palace, several convents, two hospitals, and a bull ring capable of accommodating 9,000 spectators.

**TESCHEN,** a town of Lower Silesia, Austria, on the right bank of the Olsa, 38 m. S. E. of Troppau; pop. in 1870, including suburbs, 9,779. There is some trade in local products. The principal manufactory is one for yarns, and there is also a large publishing house.—The peace concluded at Teschen, May 13, 1779, between Maria Theresa and Frederick the Great, terminated the war of the Bavarian succession. The former duchy of Teschen comprised till 1849 most of an extensive circle of the same name, now divided into eight bailiwicks.

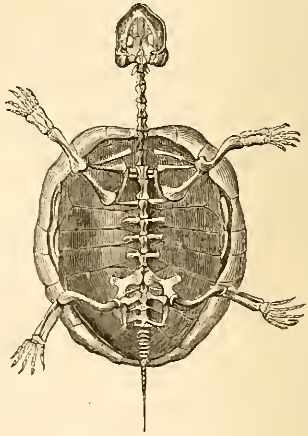
**TESSIN.** See Ticino.

**TESTAMENT.** See Will.

**TESTAMENT, Old and New.** See Bible.

**TESTIMONY.** See Evidence.

**TESTUDINATA,** a term employed by Klein, and adopted by Agassiz, synonymous with chelonians, and embracing the reptiles known as tortoises and turtles. They are the highest of the class, approaching the lower or aquatic birds in form, mode of existence, and in some points of structure; the regions of the body are distinctly marked, and the head has a considerable mobility on the neck. Duméril and Bibron divide the order into four families: *thalassites* or marine turtles; *potamites* or river tortoises; *elodites* or marsh tortoises, with the subfamilies *cryptodères*, which bend the short neck like the letter Z, and conceal the head on the median line beneath the carapace, and *pleurodères*, which curve the long neck horizontally and on the side of the body under the shell; and *chersites* or land tortoises, the highest in rank. Agassiz ("Contributions to the Natural History of the United States of America," vol. i., part 2) adopts Oppel's subdivision of the order, making the suborders: I., *chelonii*, with the families: 1, *chelonioidæ*, marine turtles, and 2, *sphargididæ*, leather or trunk turtles; and II., *amydæ*, with the families: 3, *trionychidæ*, soft-shelled tortoises; 4, *chelyoidæ* (*matamata*); 5, *hydraspididæ*, like *platemys* and other flattened species, mostly South American, united by J. E. Gray to the preceding family; 6, *chelydroidæ*, snapping turtles; 7, *cinosternoidæ*, mud turtles; 8, *emydoidæ*, fresh-water species like the terrapins; and 9, *testudinina*, land tortoises like the great Galápagos, gopher, and common European tortoises. The characters of the suborders with their families will be given under Tortoise and



Skeleton of Tortoise.

Turtle, which may be considered as corresponding to the *amydæ* and *chelonii* of Oppel. The skeleton is in great part external, the bony box being covered only by comparatively thin scales or a naked skin; the most striking character is the stiff vertebral column, spreading in the shape of a carapace or shield, connected by a lateral bridge with the plastron or ventral plate, between which the organs of the trunk are enclosed, and having an anterior and a posterior opening for the protrusion of the head, limbs, and tail, which are all free; locomotion is always performed by the four limbs. The shield consists of a hard and dry epidermic covering, under which is a bony plate made up of the vertebræ, ribs, and sternum, overlaid and the intervals filled with the ossified skin

or dermal skeleton, divided into many pieces united by suture; in the marine turtles this dermal skeleton is imperfect (especially below), less developed in the trionyx, and least of all in the trunk turtle (*sphargis*). The epidermic plates in the tortoise-shell turtle grow only on the anterior edge, the older parts moving backward, much as in the human nail; but in the land tortoises they increase below and on all sides, in concentric rings, like the annual growths of a tree; there is every intermediate stage between these types; a moulting of the epidermis takes place in all chelonians, scale by scale. In all except the imbricated turtle the colors are in the lowest layers of the epidermis; in this they exist in the external dry horny layers, displaying the beautiful and permanent hues of tortoise shell; in the corium or true skin is deposited the phosphate of lime of the dermal skeleton. The skull is solid and compact, and the facial bones are immovably fixed to the cranium; the lower jaw consists of a firm bony arch; the occipital bone strikingly resembles a vertebra; the parietals principally enclose the brain; there are two pairs of frontals, and the nasals are almost always wanting. The cervical vertebræ are nine, if the odontoid process be considered distinct, and have no transverse processes; some have a concave-convex articulation, others a convex-concave, one a biconcave (toward the lower part of the series), and one a biconvex (in the middle), giving considerable freedom of motion in certain directions without the flexibility of the bird's neck. The dorsal vertebræ are 11, of which the first is movable, the rest united into a firm arch by the continuous growth of the spinous processes; the ribs extend from between the vertebræ, being strongest where the dermal skeleton is least developed, as in *trionyx*, *sphargis*, &c.; the sternum consists of four pairs and one odd bone, varying much in size and connection, united to the ribs by a bony bridge, the marginal plates being dermal bones; the caudal vertebræ are very movable, convex behind, concave before, and without spinous processes. The scapular and pelvic arches are withdrawn under the bony roof of the body; the bones of the shoulder are long, straight, and narrow, the scapula and acromion united at right angles, the coracoid running backward among the muscles, and the three united to form the glenoid cavity; the humerus is short, crooked, and turned inward; the forearm and hand have their transverse diameter vertical, the ulna overlying the radius, so that the limb may be drawn back under the carapace by the bending of all the joints in the plane of the scapula; the form of the hand varies in the different families, according as it is used for terrestrial or aquatic locomotion. The pelvic arch is formed by three permanently distinct bones, which meet in the cotyloid cavity; the bones of the hind legs are like those of the anterior, but the femur is straighter than the humerus; there are great differences in the relative size of the two pairs of legs in the two suborders. The cervical muscles are largely developed; the muscles of the limbs are much like those of mammals. The cerebral hemispheres are hollow and larger in proportion than in other reptiles, with a generally smooth surface. There is a tympanic cavity and membrane, the former divided into two parts by a bony partition; the eyes are larger and more movable than in the lower reptiles, similar to those of birds in the lids, nictitating membrane, osseous framework of cornea, and round pupil; a lachrymal gland is present. Hearing and vision are acute, but smell is dull, the nostrils being used chiefly for their slow respiration; they chew their food, and the tongue is broad, thick, and fleshy, with an acute sense of touch; the tongue is of use also in the respiratory process, as they swallow air into the lungs. The upper jaw always shuts over the lower, and both are covered with a peculiar horny sheath; the intestines, as in the higher classes, are longest in the herbivorous families, but the proportions of the different parts vary much without any special reference to the food; the liver and gall bladder are large; spleen and pancreas always present, the former solid and generally attached to the latter, and this to the duodenum; the pancreas is lobular and irregular, and much the largest in the carnivorous feeders; digestion is performed very slowly, and hunger can be endured a long time. Respiration is effected by swallowing air, on account of the immobility of the thoracic cavity, assisted, according to Agassiz, by the diaphragm, which is well developed in the order, and by the scapular and pelvic muscles; the lungs are voluminous, most so in the land tortoises; the trionyx can remain half an hour or more under water, aëration of the blood in this and other aquatic species being doubtless partly effected, as in frogs, through the naked skin; many species have the power of emitting vocal sounds, independent of the sharp hiss which they all produce; respiration is reduced or entirely suspended in the hibernating species, according to the degree of this state. The heart is just above the liver, between its halves; the ventricle is single, divided into two cavities by an imperfect partition, and gives rise both to the two aortæ and the pulmonary artery; it beats about ten times a minute; the lymphatic system is greatly developed, two hearts near the base of the tail sending the lymph over the body. The kidneys are comparatively small, flattened and lobed, in the pelvic cavity, outside the peritoneum; the ureters short, and bladder large; the ovaries are much like those of birds, and the number of eggs matured in a year varies in different members of the order; the cloaca is very large in both sexes. All are oviparous, and the eggs are spherical, covered with a hard shell, and laid in moist or dry ground or hot sand, the number varying from four or five in the land tortoises to more than 100 in the marine turtles; the young, which

appear from the egg in from six weeks to four months or more, are generally very different in form from the parents; there is a hard tubercle on the snout of the young for breaking through the shell of the egg. The growth is very slow, and they attain the period of puberty the latest of all reptiles; they can exist a long time without nourishment, and give signs of vitality, according to Redi's experiments, 23 days after decapitation; the same experimenter ascertained that a land tortoise lived for six months, blindly groping about, after the brain had been entirely removed; they live more than a century.—Chelonians first appeared in the oölitic period, according to Agassiz, when neither genuine birds nor mammals existed; the so-called tortoise footprints in the new red sandstone and Devonian strata were undoubtedly made by crustaceans or other articulates; according to Pictet, impressions of their shields first occur in the Jura limestone and the Stonesfield oölite, and the four types of Duméril and Bibron together; they also are found in the tertiary and diluvial deposits. In the diluvium of the Sivalik hills of the Himalaya range have been found the remains of a gigantic chelonian (*colossochelys atlas*, Cautl. and Falc.), which must have been 18 to 20 ft. in length; it appears that its existence was known to the natives, as this figure enters largely into the old East Indian cosmogonies. In geological times chelonians existed in northern regions of Europe and Asia, now too cold for them; marine and fresh-water species also are often found together, a fact explained by estuary deposits, a more uniform constitution of the early waters of the globe, and a mixture by sudden inundations and surface changes. The present geographical range of chelonians is less extensive than that of the other orders of reptiles, the marine turtles having the greatest and the terrestrial species the least; the marine species are also the largest except the Galápagos tortoise.

**TETANUS**, a spasmodic disease characterized by painful, involuntary, and protracted contraction of a greater or smaller number of the voluntary muscles. As seen in temperate climates, the disease is almost invariably consequent upon a wound or injury; but in particular localities and in hot climates, it may occur without any lesion either external or internal. The disease usually begins with chills and a feeling of depression and debility, with vertigo and sleeplessness. At first there is commonly a feeling of stiffness and uneasiness about the muscles of the neck and jaws. The patient thinks he has taken cold or has a slight rheumatic affection. He finds he is unable to separate the jaws to any distance, and more or less gradually they close, so that he is unable to open the mouth at all; a condition called locked jaw. As the disease advances there is acute pain at the bottom of the stomach, extending through toward the back; and this pain, like the contractions of the voluntary muscles, is aggravated in paroxysms. Gradually the large muscles of the trunk and extremities become affected. In some cases all the muscles are firmly contracted, and the body remains stiff and straight. Ordinarily the strong extensors of the trunk and limbs are more affected than the flexor muscles, or their superior power overcomes the resistance of these latter, and during the paroxysm the body is forcibly curved backward, the patient resting upon his hands and heels only. This constitutes *opisthotonos*. Occasionally, though it must be very rarely, the body is bent forward, constituting *emprosthotonos;* and still more rarely there is lateral curvature, forming *pleurosthotonos*. The muscles concerned in deglutition are early affected, so that swallowing is rendered difficult or impossible. Later, spasms of the muscles of the face occur, the brow becoming knit, the eyes wide open, fixed and staring, the nostrils distended, and the angles of the mouth drawn back, exposing the clenched teeth, and producing an expression called *risus sardonicus*. When the disease has once set in, the muscles affected are rarely at any time afterward wholly relaxed. At intervals more or less closely approximated to each other according to the severity of the disease, paroxysms occur during which the spasm is aggravated, the muscles affected becoming tense and hard as boards. During these paroxysms the patient commonly suffers from intense pain in the muscles affected, and the substernal pain, dependent probably on spasm of the diaphragm, is likewise aggravated. Cases have occurred in which the teeth have been broken, bones fractured, or muscles torn across. The spasms come on even when the patient is perfectly at rest; but they are evidently excited by the slightest attempt at voluntary motion, by efforts at deglutition, or by mental emotion. The patient's mind is commonly unaffected throughout the disease; the bowels are apt to be obstinately constipated, and when evacuations are obtained they are offensive and unnatural. Death may occur either suddenly during a paroxysm or from suffocation, the muscles of respiration becoming fixed and the spasm in some instances probably affecting the glottis. In other cases death results from exhaustion, the patient being worn out by pain, sleeplessness, and want of nourishment.—Tetanus is fatal in the large majority of cases. Post-mortem examination throws but little light on its pathology. Dr. Lockhart Clark believes that degeneration of the cells of the spinal cord is always present; but the fact that the symptoms are so similar to those of poisoning by strychnia would lead to the opinion that the cause of the disease is in a morbid condition of the blood, although the medulla oblongata and spinal cord are the parts attacked. In cases arising from wounds, the nerve leading from the wound shows evidences of inflammation, being commonly red and swollen; but with this exception no lesions have been

found which are constantly connected with the disease.—Idiopathic tetanus, rare in temperate, is not uncommon in hot climates; but though heat acts as a predisposing cause, the exciting cause is generally exposure to damp and cold. In traumatic tetanus, exposure to cold, particularly when the body is debilitated by previous warm weather, seems to be an efficient cause. Thus the wounded in the battle of Dresden, who were exposed to cold and wet just after the battle, while the previous weather had been hot and oppressive, suffered severely from tetanus; and after the battle of Bautzen, where the wounded lay on the field exposed to cold and rain during the night, Larrey found more than 100 attacked with tetanus the next morning. Tetanus is more liable to follow punctured and lacerated than incised wounds; and wounds of the palmar surface of the feet and hands, which are abundantly supplied with nerves, are particularly dangerous, but it may follow wounds of every character. Even those made by the knife of the surgeon and the stroke of a whip, the cutting of a corn and extraction of a tooth, have all been followed by this formidable and fatal disease. Cases are on record in which lying-in women have been seized by the disease. The time which elapses between the reception of the injury and the period of invasion of the disease varies greatly. Larrey says that during the campaign in Egypt it rarely appeared before the fifth or after the fifteenth day; yet some cases are on record in which it came on in a few hours, and others in which it was delayed for more than a month. When the paroxysms come on suddenly, recur at short intervals, and increase in violence, treatment is rarely of any avail; death in such cases occurs often as early as the second, and is rarely delayed beyond the fifth day. When the attack is less violent and the interval between the paroxysms longer, the prospects of the patient are better, and if life is protracted beyond the tenth day he will frequently recover.—The treatment of tetanus is unsatisfactory. The inhalation of chloroform has been strongly recommended, and where it is well borne, it mitigates greatly the sufferings of the patient. Opium has been given in large and repeated doses; when recourse is had to it, it should be administered in a liquid form, or some salt of morphia should be used. A strong solution of the sulphate of morphia may be given by subcutaneous injection. Wine and distilled spirits, with or without opium, have been given in large quantities, and in many cases apparently with benefit. The bowels should be occasionally moved by active purgatives. But as the paroxysms are mainly excited by external sources of irritation, even slight ones, the principle of the treatment should be to keep the patient perfectly quiet. Stillness, a darkened apartment, few attendants, and the absence as far as possible of all causes of physical or mental disturbance, promise a better chance of recovery than any active interference or the repeated administration of medicinal agents.

**TETUAN**, a city and seaport of Morocco, in the province of Fez, at the W. end of the Mediterranean, 21 m. S. by W. of Ceuta; lat. 35° 37′ N., lon. 5° 18′ W.; pop. about 20,000. The town is about 6 m. W. of the coast, on high ground, which rises on the south into a ridge 3,000 ft. high. It is surrounded by a wall flanked with towers, and is defended by a castle. The streets are narrow and dirty, but there are some fine buildings, particularly mosques, of which there are 40. Its harbor is an open roadstead unprotected on the east, and is fit for small vessels only. The town has manufactures of leather, leather goods, swords, and firearms, and a considerable inland trade through Fez. Its foreign trade consists principally in supplying Gibraltar with provisions. In 1873, 211 vessels, of 2,716 tons, entered its port. The value of its imports was $111,555; exports, $55,775. Tetuan was captured by the Spaniards in 1860, but was given up in the following year.

**TETZEL**, or **Tezel, Johann**, a German monk, born in Leipsic about 1460, died there in August, 1519. He studied theology and philosophy at the university of Leipsic, and in 1489 entered the order of Dominicans. He gained celebrity as a popular preacher, and was repeatedly engaged to preach indulgences granted by the pope to raise money for religious purposes. The early Protestant biographers of Tetzel say that he sold certificates of indulgence without requiring previous confession, and indulgences for future sins; that he led a very immoral life, and was even convicted at Innspruck of adultery; but Catholic historians have generally qualified these statements as gross exaggerations, though they admit that he often offered the indulgences in an offensive and mountebank way. In 1516 Tetzel began the publication of an indulgence designed to procure means for the construction of St. Peter's at Rome, receiving at the same time an appointment as inquisitor. Never before had the preaching of an indulgence produced such a commotion. He is said to have assured the people that as soon as the money resounded in the chest their sins would be forgiven, and the souls of the departed received into heaven; but Catholics maintain that this is conclusively refuted by the *Instructio Summaria Sacerdotum ad Prædicandas Indulgentias*, prepared by Tetzel in 1517, in which he makes the gaining of an indulgence expressly dependent upon repentance and confession. As a delegate of the highest ecclesiastical authorities, Tetzel was generally received with great pomp, but at the same time met with a powerful and rapidly increasing opposition. On Oct. 31, 1517, Luther posted the celebrated 95 theses against the abuses in preaching indulgences on the doors of the church in Wittenberg. Tetzel publicly burned the theses at Jüterbogk, and in January, 1518,

in a public disputation at the university of Frankfort-on-the-Oder, defended several antitheses. The students of Wittenberg, in their turn, burned 800 copies of the antitheses of Tetzel. Tetzel replied once more, in May, by a refutation of the sermon of Luther on indulgences and grace, but seems to have had no longer any influence on public opinion. Among the latest biographers of Tetzel are Hoffmann, a Protestant (*Lebensbeschreibung von Tetzel*, Leipsic, 1844), and Gröne, a Roman Catholic (*Tetzel und Luther, oder Lebensgeschichte und Rechtfertigung des Ablasspredigers und Inquisitors Dr. Johann Tetzel*, &c., Soest, 1853).

**TEUCER** (Gr. Τεῦκρος). **I.** The first king of Troy, son of the river god Scamander by the nymph Idæa, after whom the Trojans are sometimes called Teucrians. **II.** A Grecian hero in the war against Troy, the son of Telamon, king of Salamis, and Hesione of Crete, and a half brother of Ajax. He was the best archer among the Greeks; but on his return from Troy his father refused to receive him in Salamis because he had not avenged the death of Ajax nor brought back his body. He therefore settled in the island of Cyprus, and founded there the city of Salamis.

**TEUFFEL, Wilhelm Sigismund,** a German philologist, born in Ludwigsburg, Sept. 27, 1820, died March 8, 1878. He studied at the university of Tübingen, devoted himself to the critical study of Horace, and published valuable papers on the works and times of that author. In 1845 he became editor of the *Realencyklopädie der classischen Alterthumswissenschaft*, begun by Pauly. In 1849 he was appointed professor of classical philology in Tübingen. He especially studied the literary history of Greece and Rome, and also of Germany, and his various publications on single authors, as Juvenal, Aristophanes, and Æschylus, were universally received as important. His principal work, *Geschichte der römischen Literatur* (2 vols., Leipsic, 1868–'70), has been translated into several languages (London, 1874).

**TEUTOBURG FOREST,** a mountain chain of Germany, partly in the principality of Lippe, partly in Prussia, extending, at first under the name of Egge, in a N. direction through the territory of Paderborn to Driburg, then N. W. toward Bielefeld and Halle, and terminating at the Bervergern, 5 m. E. of Rheine on the Ems. Its total extent is about 80 m. It reaches its highest point of more than 1,500 ft. near Horn in Lippe. According to Tacitus, the Roman legions of Varus were defeated (A. D. 9) in this mountain region, which he calls *Teutoburgiensis saltus*, by Arminius, prince of the Cherusci, whose memory is celebrated as that of the liberator of Germany. (See ARMINIUS.) His colossal monument by Bandel was unveiled by the emperor of Germany, Aug. 16, 1875, amid national rejoicings, on the summit of the Grotenberg near Detmold. (See BANDEL.)

**TEUTONIC KNIGHTS,** or **Knights of the Hospital of St. Mary in Jerusalem,** a powerful religious and military order which originated during the crusades. The hospital of St. Mary in Jerusalem, from which the order derives its canonical name, was founded soon after the capture of Jerusalem by the crusaders in 1099. A German merchant and his wife threw open their dwelling to the poor and sick of their own nation; a chapel was afterward attached to the house by permission of the patriarch and dedicated to St. Mary. The establishment, to which the founder devoted all his wealth, was after its extension maintained by alms collected among the Germans; and a number of distinguished persons also devoted their property and services to the same purpose, assuming a religious dress and binding themselves by monastic vows (1119), with the approbation of Pope Calixtus II. During the siege of Acre in 1189 charitable burghers of Bremen and Lübeck established a guild of hospitallers for German soldiers, whose numbers were so great after the death of Frederick Barbarossa that the merchants made tents with the sails of their vessels, and called to their assistance the brethren of St. Mary in Jerusalem. Both confraternities were then organized into one order by Duke Frederick of Swabia, who obtained the approbation of Pope Celestine III., Feb. 23, 1192. The new order retained the rule of St. Augustine adopted by the German brotherhood in Jerusalem. None were at first admitted to membership but Germans of noble birth; about 1221 half-knights or sergeants, as among the templars and hospitallers, were added, as well as priest-chaplains. The dress was black with a white mantle, upon which was a black cross with a silver edging. The order had an elective grand master, who first dwelt at Jerusalem, then when Palestine fell into the hands of the Turks at Venice, and at the close of the 13th century at Marburg. Conrad, duke of Masovia, called the Teutonic knights, then under the famous grand master Hermann of Salza, to his assistance about 1226, to repel the incursions of the heathen Prussians and Lithuanians, and to help in spreading the gospel among them. He gave them the territory of Culm on the Vistula, and from this point they extended their conquests over the territory of Prussia, and with the aid of the knights sword-bearers over Courland and Livonia, exterminating the pagan inhabitants with fire and sword. In 1309 the grand master fixed his seat at Marienburg. Possessing the richest and most commercial provinces of the north, the order became exceedingly powerful; and at the beginning of the 15th century, when it had reached its greatest prosperity, its territory extended from the Oder to the gulf of Finland, and its yearly revenue was estimated at 800,000 marks. Nobles from all parts of Europe flocked to its banner. Internal dissensions, luxury, and unjust and oppressive acts threatened its decline from this period, and a conflict with the Polish kings hastened it. In the

battle of Grünwald or Tannenberg in 1410 they were totally defeated by Ladislas Jagellon; and after a subsequent long war with Casimir IV., West Prussia was given up to Poland, and for East Prussia they were compelled to do homage (1466). An attempt to regain their independence deprived them of East Prussia, which in 1525 was presented by Sigismund I. of Poland to the grand master, the margrave Albert of Brandenburg, as a hereditary duchy. The order was now reduced to a mere shadow of its former greatness. In 1527 the grand master fixed his seat at Mergentheim in Swabia, became a spiritual prince of the German empire, and had under him 11 provinces divided into commanderies. In 1805 the peace of Presburg gave to the emperor of Austria the rights, revenues, and possessions of grand master of the Teutonic order; but in the campaign of 1809 Napoleon while at Ratisbon abolished the order on April 24, its widely scattered territory, comprising about 850 sq. m. with 88,000 inhabitants, falling to the princes in whose dominions it was. It was revived in the Austrian empire in 1834 and placed under the protection of the imperial family; it was more fully reorganized in 1840. From 1863 till his death in Mexico, the archduke Maximilian was grand master. The present grand master is the archduke Wilhelm.

**TEUTONS** (Lat. *Teutones* or *Teutoni*), a powerful people of ancient Germany, who probably dwelt on the southern shores of the Baltic, in the vicinity of the Cimbri, together with whom they invaded the dominions of the Roman republic at the close of the 2d century B. C., when they were annihilated by Marius. (See CIMBRI.) The name Teutons is also applied to the ancient Germans in general. (See GERMANIC RACES AND LANGUAGES.)

**TEWKESBURY**, a market town of Gloucestershire, England, at the confluence of the Avon and Severn, 108 m. W. by N. of London; pop. in 1871, 5,409. It has an old church in the Norman style, town hall, mechanics' library, and stocking, lace, and nail manufactories. Edward IV. here defeated the Lancastrians in 1471.

**TEXAS**, a S. W. state of the American Union, the 15th admitted under the constitution, situated between lat. 25° 50′ and 36° 30′ N., and lon. 93° 30′ and 106° 40′ W.; greatest length, from the mouth of the Rio Grande to the N. W. corner, about 825 m.; greatest breadth, along the 32d parallel, about 740 m.; area, 274,356 sq. m., being greater than that of any other state or territory except Alaska, and nearly six times as great as that of New York. It is bounded N. by New Mexico (W. of the 103d meridian), the Indian territory, and Arkansas, the Red river being the dividing line E. of the 100th meridian; E. by the Indian territory (N. of lat. 34° 30′), Arkansas, and Louisiana, from the last of which it is mostly separated by the Sabine river and lake; S. E. by the gulf of Mexico; S. W. by Mexico, from which it is separated by the Rio Grande; and W. by New Mexico. The state is (1876) divided into 174 counties, of which 26, marked with an *, are unorganized, viz.: Anderson, Angelina, Aransas, Archer,* Atascosa, Austin, Bandera, Bastrop, Baylor,* Bee, Bell, Bexar, Blanco, Bosque, Bowie, Brazoria, Brazos, Brown, Burleson, Burnet, Caldwell, Calhoun, Callahan,* Cameron, Camp, Cass, Chambers, Cherokee, Clay, Coleman, Collin, Colorado, Comal, Comanche, Concho, Cooke, Coryell, Crockett,* Dallas, Dawson,* Delta, Denton, De Witt, Dimmitt,* Duval,* Eastland, Edwards,* Ellis, El Paso, Encinal,* Erath, Falls, Fannin, Fayette, Fort Bend, Franklin, Freestone, Frio, Galveston, Gillespie, Goliad, Gonzales, Grayson, Greer* (see GREER), Gregg, Grimes, Guadalupe, Hamilton, Hardeman,* Hardin, Harris, Harrison, Haskell,* Hays, Henderson, Hidalgo, Hill, Hood, Hopkins, Houston, Hunt, Jack, Jackson, Jasper, Jefferson, Johnson, Jones,* Karnes, Kaufman, Kendall, Kerr, Kimble,* Kinney, Knox,* Lamar, Lampasas,


State Seal of Texas.

La Salle,* Lavaca, Lee, Leon, Liberty, Limestone, Live Oak, Llano, McCulloch,* McLennan, McMullen,* Madison, Marion, Mason, Matagorda, Maverick, Medina, Menard, Milam, Montague, Montgomery, Morris, Nacogdoches, Navarro, Newton, Nueces, Orange, Palo Pinto, Panola, Parker, Pecos, Polk, Presidio, Rains, Red River, Refugio, Robertson, Rockwall, Runnels,* Rusk, Sabine, San Augustine, San Jacinto, San Patricio, San Saba, Shackleford, Shelby, Smith, Somerville, Starr, Stephens,* Tarrant, Taylor,* Throckmorton,* Titus, Tom Green, Travis, Trinity, Tyler, Upshur, Uvalde, Van Zandt, Victoria, Walker, Waller, Washington, Webb, Wegefarth,* Wharton, Wichita,* Wilbarger,* Williamson, Wilson, Wise, Wood, Young, Zapata, Zavala.* An extensive region in the W. part of the state N. of the 32d parallel is not divided into counties, the N. portion being known as Bexar territory and the S. portion as Young territory. The principal cities are Galveston (pop. in 1870, 13,818), San Antonio (12,256), Houston (9,382), Brownsville (4,905), Austin (the capital, 4,428), and Jeffer-

son (4,190). Other important places are Bastrop, Bonham, Brazoria, Bremond, Brenham, Columbus, Corpus Christi, Dallas, Eagle Pass, Fairfield, Fredericksburg, Gonzales, Henderson, Huntsville, Independence, Indianola, La Grange, Laredo, Lavaca, Marshall, Nacogdoches, Navasota, New Braunfels, Richmond, San Marcos, Seguin, Sherman, Sulphur Springs, Victoria, Waco, and Waxahachie. The population of Texas in 1806 has been estimated at 7,000; in 1834, at 21,000; in 1836, at 38,500; and in 1845, at 150,000. The results of the three federal censuses are as follows:

| YEARS. | Whites. | Free colored. | Slaves. | Total. | Gain per cent. | Rank. |
|---|---|---|---|---|---|---|
| 1850 ... | 154,034 | 397 | 58,161 | 212,592 | ...... | 25 |
| 1860 ... | 420,891 | 355 | 182,566 | 604,215 | 184·20 | 23 |
| 1870 ... | 564,700 | 253,475 | ...... | 818,579 | 35·48 | 19 |

The total for 1860 includes 403 Indians, and that for 1870 379 Indians and 25 Chinese. There are very few inhabitants W. of the 100th meridian, except along the Rio Grande. In the vicinity of San Antonio there is a large population of German origin. Of the total population in 1870, 423,557 were males and 395,022 females, 756,168 native and 62,411 foreign born. Of the natives, 388,510 were born in the state, 62,224 in Alabama, 51,435 in Tennessee, 42,537 in Mississippi, 41,206 in Georgia, 27,290 in Louisiana, 23,357 in Arkansas, 22,165 in Virginia and West Virginia, 18,655 in North Carolina, 18,419 in Missouri, 17,813 in Kentucky, 17,717 in South Carolina, 5,854 in Illinois, 2,873 in New York, 2,783 in Indiana, 2,385 in Maryland, 2,052 in Ohio, 1,934 in Florida, and 1,877 in Pennsylvania. Of the foreigners, 23,985 were natives of Germany, 23,020 of Mexico, 6,762 of the British isles (including 2,037 English and 4,031 Irish), 2,232 of France, and 1,748 of Austria (proper). Of the colored population, 225,658 were blacks and 27,817 mulattoes. There were 145,184 males and 139,667 females between 5 and 18 years of age, 158,765 males from 18 to 45, and 184,094 males 21 and upward, of whom 169,258 were citizens of the United States and 14,736 unnaturalized foreigners. The number of families was 154,483, with an average of 5·3 persons to each; of dwellings, 141,685, with an average of 5·78 to each. Of persons 10 years old and upward, 189,423 could not read, and 221,703 could not write; of the latter 203,334 were natives and 18,369 foreigners, 110,562 males and 111,141 females, 70,895 whites, 150,617 colored, and 191 Indians; 47,636 were between 10 and 15 years of age, 41,768 between 15 and 21, and 132,299 21 and upward, of whom 64,819 were males. There were 404 blind persons, 232 deaf and dumb, 270 insane, and 451 idiotic. Of the 237,126 persons 10 years old and upward returned as engaged in all occupations, there were employed in agriculture 166,753, including 81,123 agricultural laborers, 79,015 farmers and planters, 3,338 stock raisers, and 2,049 stock herders; in professional and personal services, 40,882, including 831 clergymen, 13,692 domestic servants, 14,371 laborers, 1,027 lawyers, 1,906 physicians and surgeons, and 1,709 teachers; in trade and transportation, 13,612; and in manufactures and mining, 15,879.—Texas may be divided into four sections, eastern, central or middle, western, and northern Texas. Eastern Texas embraces the territory between the Sabine and Trinity rivers, and is the great timber region of the state, there being only a few prairies confined to the gulf coast. The southern portion is low and level, the northern rolling and elevated, but not mountainous. The greater portion of central Texas, between the Trinity and Colorado rivers, is prairie, but there is considerable timber along the streams. Northern Texas, including two or three tiers of counties from Red river, is about equally divided between prairie and forest. Western Texas embraces the region between the Colorado and Rio Grande rivers. Prairies cover about four fifths of its surface; with the exception of occasional districts covered with post oak or the mezquite tree, timber is confined almost entirely to the valleys of the streams, which are densely wooded. The N. W. extremity of the state, between Indian territory and New Mexico, is known as the "panhandle." In general, the S. and S. E. portion, along the coast, is level and of little elevation; N. of this the country is undulating; the W. and N. W. region is mostly an elevated table land; while the district between the Pecos and Rio Grande is mountainous. The table land includes a large portion of the Llano Estacado, and has been but imperfectly explored; it is said to vary from 2,000 to 4,000 ft. in height. The Llano Estacado or Staked Plain (so named from the great abundance of yucca stems, resembling stakes) extends from the Rio Pecos in New Mexico on the west to the head waters of the Colorado, Brazos, and Red rivers on the east, and from the valley of the Canadian on the north to the Pecos on the south. Its surface is gently undulating; vegetation is scanty, owing to the dryness of the climate and the lack of streams. The principal ranges between the Pecos and Rio Grande are the Guadalupe, Sierra Hueca, Eagle, Sierra Blanca, and Apache mountains, attaining in places an elevation of between 5,000 and 6,000 ft. Between the upper waters of the Colorado and Brazos is a large tract of timbered land known as the "mezquite timber," and between the upper Brazos and Trinity a long tract from 5 to 30 m. in width, extending from Johnson co. to the Canadian river in Indian territory, and called the Cross Timbers. —The coast of Texas, which extends along the gulf of Mexico about 400 m., is bordered with a chain of low sand islands, between which and the mainland lie a series of bays, sounds, and lagoons; the most important of these, beginning at the northeast, are Galveston, Matagor-

da, Espiritu Santo, Aransas, and Corpus Christi bays, and the Laguna del Madre. Galveston bay is the largest, and has the best entrance, its inlet having 13 ft. of water, while in good anchorage just outside there is 24 ft.; it extends inland from the gulf of Mexico 35 m. Matagorda bay, nearly 60 m. long by 6 to 10 m. wide, and Laguna del Madre, nearly 100 m. long by 3 to 6 m. wide, are properly sounds, and run parallel with the shore. The entrance of Matagorda bay, which is rapidly filling up, has only 7 ft. of water; and San Luis inlet, the entrance to West bay, a sound connecting with Galveston bay, has but 6 ft. Aransas bay is 25 m. long from N. E. to S. W. and about 10 m. wide, and Copano bay, a sound opening into it, is 20 m. long by 3 m. wide; Corpus Christi bay is 20 m. long by 15 m. wide, and Espiritu Santo 20 by 10 m. The entrance to all these is much obstructed by the bars at the inlets.—E. of the 100th meridian the state is generally well watered. The Rio Grande forms the boundary with Mexico, and is navigable for 400 or 500 m. The Rio Pecos, its principal tributary, entering from New Mexico, flows S. E. through the W. extremity of the state. The most important rivers, proceeding N. E. along the coast from the mouth of the Rio Grande, are: the Nueces, emptying into Corpus Christi bay; the San Antonio and Guadalupe, into Espiritu Santo bay; the Lavaca, into Lavaca bay and thence into Matagorda bay; the Colorado, into Matagorda bay; the Brazos, into the gulf of Mexico; the San Jacinto and Trinity, into Galveston bay; and the Neches and Sabine, into Sabine lake, which discharges into the gulf of Mexico through Sabine pass. The Sabine rises in the N. E. part of Texas, flows S. E. to the Louisiana border (about lat. 32°), and thence S., separating the two states. It is navigable in some portions by small craft. The Neches and its chief tributary, the Angelina, are navigable for about 200 m. from Sabine lake. The Trinity rises in the N. part of the state near the Red river, and flows S. S. E.; it is navigable for about 250 m. The Brazos, Colorado, Guadalupe, San Antonio, and Nueces rivers are during most of the year navigable but a short distance, though susceptible of improvement. The chief tributary of the Nueces is the Rio Frio. The Colorado and Brazos rise on the E. edge of the Llano Estacado, and flow S. E. across the state. The chief tributaries of the former are the Concho, San Saba, and Llano from the west; of the latter, the Little river from the west and the Navasota from the east. The N. E. corner of the state is watered by the Sulphur fork of Red river, which joins the main stream in Arkansas. A little S. of this are Big and Little Cypress bayous, which discharge through lakes into Red river in Louisiana. Red river rises by several forks in the N. W. part of the state, flows E., and after crossing the 100th meridian separates Texas from Indian territory and Arkansas, and enters the latter state. It is navigable for nearly its whole course on the boundary, though obstructed somewhat by shifting sands for a part of the distance. Its largest Texan tributary is the Big Wichita, entering near lon. 98°. The N. extremity of the state is crossed by Canadian river, running E. from New Mexico into Indian territory.—The principal geological formations are the alluvial, tertiary, cretaceous, and carboniferous. The alluvial extends along the gulf coast; back of this is the tertiary, having its widest expansion in the east, where it reaches Red river in Lamar co.; N. W. of the tertiary is the cretaceous, extending W. on Red river to Cooke co. and S. to San Antonio, and probably forming the table lands and plains of the west and southwest. The carboniferous formation extends through the counties W. of Cooke to the Staked Plain, stretching S. from Red river to and beyond the upper Colorado. Coal beds have been discovered here, but scarcely anything has been done to test the quality or quantity of the mineral. Coal has also been found at various points in the tertiary, particularly in Bastrop co., W. of the Colorado; in Milam, Robertson, Leon, and Limestone cos., near the Brazos and Trinity; and in Anderson and Rusk cos., in eastern Texas. The tertiary coal has to some extent been proved valuable for fuel. Iron ores are abundant in the tertiary in eastern and central Texas; they also occur in the N. W. part of Grayson co., on Red river, and in the upper Cross Timbers; in Burnet and Llano cos., N. W. of Austin; and also, it is said, in Stephens co., further N. They were worked during the civil war in Cherokee and Nacogdoches cos., in eastern Texas, and in Bowie and other counties in the N. E. corner of the state. Copper ore occurs in the carboniferous formation, particularly in the N. part. Lead has been found in connection with silver in western Texas; steatite or soapstone in Llano co.; and marble of various colors and fair quality in Burnet, Llano, and San Saba cos. In the N. W. part of the state, about the head waters of Red river, is an extensive gypsum region. There are salt wells in Van Zandt co., in the northeast, in Young and Wise cos., in the northwest, and in Lampasas and Llano cos., on the Colorado. Salt beds are reported in the gypsum region and on the Rio Pecos. Between Corpus Christi and Brownsville are many shallow lagoons or arms of the gulf, which during the prevalence of winds blowing inland are filled with salt water. This is evaporated, depositing the salt, which is collected upon the subsidence of the water. Chalybeate springs are common in the iron districts of the tertiary. At Lampasas in the county of the same name are fine sulphur springs, which also exist in Grimes, Rusk, and Hopkins cos., in the E. part of the state.—The climate is remarkably salubrious, and though warm enough for the production of most of the semi-tropical and some of the tropical

fruits, it is less enervating and more free from malarious diseases than that of any other of the gulf states. Northers, cool, dry winds, occur from October to May at intervals of about a week, rarely lasting more than three days. They produce a sudden depression in the temperature, but are said to make the climate more healthful and the air purer. The heat of summer is tempered by winds from the gulf, which blow far inland. The mean annual temperature in the southwest, near the mouth of the Rio Grande, is 72°; about the parallel of Austin, 68°; thence N. it gradually diminishes to 60° along the Red river. The highlands in the west are cooler, and in the extreme northwest the mean annual temperature is not more than 56°. The thermometer seldom falls below 25° in winter or rises above 95° in summer. The E. and S. portions have the most rain; as we proceed N. W. from the gulf, the moisture diminishes. The average annual rainfall in the northeast is 48 in., decreasing to 24 in. in the southwest near the gulf. In the extreme northwest it is only 16 in., and at some points between the Pecos and Rio Grande not more than 8 in. The following are the results of observations for 17 years (1858 to 1874 inclusive) at Austin (lat. 30° 15′, lon. 97° 47′): mean annual temperature, 67·61°, varying from 65·82° in 1869 to 68·92° in 1862; mean temperature of the hottest month (July), 84°; of the coldest month (January), 50°; minimum observed, 6°; maximum observed, 106°; average annual rainfall, 34·54 in., varying from 23·17 in 1862 to 48·79 in 1874. The most rain fell in September (average 4·96 in.) and the least in December (average 1·93 in.). Corn planting usually begins about the middle of February, and grain is harvested in the latter part of May, and Indian corn in July. Cotton picking begins about July 10, and continues to Dec. 1. The number of deaths, according to the census of 1870, was 11,197, of which there were from general diseases 3,848, including 680 from consumption, 464 from enteric fever, 596 from intermittent fever, and 327 from remittent fever; from diseases of the nervous system, 1,430; of the circulatory system, 204; of the respiratory system, 1,979, including 1,499 from pneumonia; of the digestive system, 1,498.—The soil of Texas is in general very fertile. The river bottoms are unsurpassed in this respect by those of any state of the Union. There are three or four varieties of soil, each well adapted to certain crops. The stiff black soil of the river bottoms is fittest for sugar and cotton, though the latter grows well on the prairies and uplands; the finer black or chocolate-colored soil of the prairie lands yields abundant crops of corn and the cereals, and the lighter copper-colored soil of the uplands is admirable for the grasses and fruits; while the fine silt of the islands produces the best sea island cotton known. The soil of the desert tracts of the northwest is sandy and charged with carbonate of soda and other alkalies; but even this, wherever it can be irrigated, produces grass and herbage moderately. Irrigation has been successfully practised in some instances in the west, where rain is scanty. In 1875 an act was passed granting land in aid of companies organized for constructing canals for irrigation and navigation. Texas is especially noted as a stock-raising country, for which the mildness of its climate and the great variety of its nutritious grasses peculiarly fit it. The W. portion, even where too dry for agriculture, is particularly adapted to cattle and sheep, and here are vast herds and flocks. Large numbers of horses and hogs are also kept. The buffalo and deer are found in the northwest, and wild horses or "mustangs" roam over the W. prairies. The other wild animals and the birds are similar to those of other portions of the Union. Among the more important grasses are the mezquite grasses of the west, which afford excellent pasturage at all seasons. The principal forest trees, of some of which several species occur, are the oak, elm, maple, hickory, pecan, sycamore or buttonwood, magnolia, willow, pine, cypress, mulberry, cedar, sweet gum, ash, walnut, palmetto, cottonwood, Osage orange, and mezquite. Eastern Texas is an extensive pine region. The principal species in the north is the short-leafed pine (*pinus mitis*), and in the south the long-leafed (*P. palustris*); the latter is valuable for timber and turpentine. The soil of the pine lands, though sandy, is productive. The cypress occurs in swamps and on the river banks in various parts of the state, and attains a great size. The live oak extends N. through central and western Texas to the Red river. The Osage orange is especially valuable for hedges, and in northern Texas attains a large size. The mezquite is one of the indigenous trees of Texas, growing in the west, valuable for fuel and for various other uses. (See Mezquite.) Numerous species of cactus are abundant W. of the Nueces river. Peaches do well in a large portion of the state, and apples thrive in the north. Pears, blackberries, and strawberries are also raised. Seven species of grapes are indigenous. In the south figs and oranges may be produced. The chief crops are cotton, Indian corn, and wheat. Cotton and corn may be grown in nearly every part of the state. Wheat is raised chiefly in the north. The sugar cane is cultivated principally on the Brazos near its mouth, and rice in the S. E. corner of the state. Oats, barley, beans, tobacco, and sweet and Irish potatoes are also raised to some extent.—The number of acres of land in farms according to the census of 1870 was 18,396,523, of which 2,964,836 were improved; number of farms, 61,125, of which 717 contained under 3 acres each, 4,659 from 3 to 10, 13,594 from 10 to 20, 24,620 from 20 to 50, 10,890 from 50 to 100, 6,268 from 100 to 500, 305 from 500 to 1,000, and 72 more than 1,000; cash value of farms, $60,149,950; of farming implements

and machinery, $3,396,793; amount of wages paid during year, including value of board, $4,777,638; estimated value of all farm productions, including betterments and additions to stock, $49,185,170; value of orchard products, $69,172; of produce of market gardens, $74,924; of forest products, $66,841; of home manufactures, $293,308; of animals slaughtered or sold for slaughter, $4,835,284; of all live stock, $37,425,194. The productions were 66,173 bushels of spring wheat, 348,939 of winter wheat, 20,554,538 of Indian corn, 762,663 of oats, 44,351 of barley, 28,521 of rye, 44 of buckwheat, 42,654 of peas and beans, 208,383 of Irish potatoes, 2,188,041 of sweet potatoes, 7 of clover seed, 497 of grass seed, 2 of flax seed, 63,844 lbs. of rice, 59,706 of tobacco, 1,251,328 of wool, 3,712,747 of butter, 34,342 of cheese, 51 of hops, 25 of flax, 13,255 of wax, 275,169 of honey, 6,216 gallons of wine, 5,032 of maple molasses, 174,509 of sorghum molasses, 246,062 of cane molasses, 2,020 hogsheads of cane sugar, 5 tons of hemp, 18,982 of hay, and 350,628 bales of cotton. There were on farms 424,504 horses, 61,322 mules and asses, 428,048 milch cows, 132,407 working oxen, 2,933,588 other cattle, 714,351 sheep, and 1,202,445 swine; besides which there were 150,137 horses and 496,115 neat cattle not on farms. The number of cattle was greater than in any other state. In 1873 718,247 horses and mules, 3,175,682 cattle, and 1,476,844 sheep were returned by the assessors.—There were 2,399 manufacturing establishments in 1870, having 540 steam engines of 11,214 horse power, and 116 water wheels of 1,830 horse power; hands employed, 7,927; capital invested, $5,284,110; wages paid, $1,787,835; value of materials used, $6,273,193; of products, $11,517,302. The particulars of the principal branches are as follows:

| INDUSTRIES. | Establishments. | Hands employed. | Capital. | Value of products. |
|---|---|---|---|---|
| Agricultural implements.... | 12 | 44 | $12,550 | $42,120 |
| Blacksmithing .............. | 380 | 761 | 177,285 | 534,550 |
| Boots and shoes............ | 98 | 186 | 56,710 | 166,761 |
| Bread and other bakery products................ | 14 | 85 | 35,800 | 93,685 |
| Brick........................ | 24 | 268 | 82,175 | 172,670 |
| Butchering .................. | 7 | 117 | 79,150 | 484,775 |
| Carpentering and building.. | 147 | 899 | 154,065 | 632,067 |
| Carriages and wagons...... | 115 | 325 | 130,585 | 289,124 |
| Cars, freight and passenger. | 1 | 16 | 12,000 | 45,905 |
| Clothing, men's............ | 83 | 78 | 18,800 | 85,457 |
| Cotton goods............... | 4 | 291 | 496,000 | 374,598 |
| Flouring and grist-mill products.................... | 533 | 1,123 | 1,066,893 | 2,421,047 |
| Food preparations, animal.. | 2 | 13 | 2,545 | 43,000 |
| Furniture.................... | 54 | 140 | 97,400 | 209,526 |
| Gas ......................... | 2 | 13 | 355,500 | 91,210 |
| Hides and tallow........... | 6 | 112 | 65,000 | 272,740 |
| Iron castings............... | 6 | 30 | 54,000 | 77,000 |
| Leather, tanned............ | 34 | 62 | 37,476 | 60,524 |
| " curried.......... | 22 | 28 | 17,367 | 57,387 |
| Liquors, malt.............. | 27 | 76 | 117,300 | 145,840 |
| Lumber, sawed ............ | 324 | 1,750 | 870,491 | 1,960,851 |
| Machinery.................. | 11 | 123 | 187,550 | 170,210 |
| Meat packed, beef.......... | 15 | 275 | 200,500 | 1,052,106 |
| Molasses and sugar, refined. | 3 | 155 | 50,220 | 75,137 |
| Oil, cotton-seed ............ | 2 | 23 | 46,000 | 39,400 |
| Printing and publishing, newspaper............... | 25 | 158 | 103,675 | 194,430 |
| Saddlery and harness....... | 138 | 292 | 153,590 | 848,307 |
| Sash, doors, and blinds..... | 10 | 118 | 140,000 | 266,400 |
| Tin, copper, and sheet-iron ware .................... | 71 | 237 | 154,136 | 334,665 |
| Wheelwrighting ........... | 86 | 140 | 33,645 | 102,020 |
| Wool-carding and cloth-dressing.................. | 18 | 41 | 28,250 | 74,372 |
| Woollen goods............. | 2 | 59 | 69,000 | 78,596 |

—Texas is divided into five customs districts: Brazos de Santiago (port of entry, Brownsville), Corpus Christi (the same), Paso del Norte (El Paso), Saluria (Indianola), and Texas (Galveston). The chief item of export is cotton. The trade with Mexico is important. There are no returns of the trade with other portions of the Union. The following table contains details of the foreign commerce for the year ending June 30, 1875:

| DISTRICTS. | Imports. | Exports of domestic products. | Exports of foreign products. | ENTRANCES. | | CLEARANCES. | |
|---|---|---|---|---|---|---|---|
| | | | | No. | Tons. | No. | Tons. |
| Brazos de Santiago........................ | $2,002,748 | $833,312 | $997,658 | 49 | 30,984 | 41 | 20,956 |
| Corpus Christi.......................... | 322,803 | 205,557 | 243,966 | 8 | 5,142 | 9 | 5,930 |
| Paso del Norte........................ | 308,991 | 40,323 | ........ | 18 | 4,080 | 18 | 4,079 |
| Saluria .................................. | 97,663 | 237,294 | 40,165 | 18 | 16,785 | 28 | 24,359 |
| Texas ..................................... | 1,218,034 | 15,876,632 | 349,275 | 163 | 91,913 | 206 | 127,579 |
| Total.................................. | $3,950,239 | $17,193,118 | $1,631,064 | 256 | 148,904 | 302 | 182,903 |

The entrances and clearances in the coastwise trade during the same period, with the number and tonnage of vessels registered, enrolled, and licensed on the above date, are as follows:

| DISTRICTS. | ENTRANCES. | | CLEARANCES. | | REGISTERED, &C. | |
|---|---|---|---|---|---|---|
| | No. | Tons. | No. | Tons. | No. | Tons. |
| Brazos de Santiago.. | 46 | 36,504 | 18 | 11,019 | 14 | 1,546 |
| Corpus Christi...... | 82 | 52,023 | 43 | 9,310 | 35 | 774 |
| Paso del Norte...... | 79 | 14,888 | 71 | 13,567 | .. | .... |
| Saluria............. | 214 | 197,534 | 52 | 11,519 | 46 | 1,612 |
| Texas............... | 453 | 418,645 | 335 | 290,426 | 250 | 18,116 |
| Total.......... | 874 | 719,594 | 519 | 335,841 | 345 | 22,048 |

—On Oct. 1, 1875, there were 10 national banks in the state, of which the resources were as follows: loans and discounts, $1,366,805 99; bonds for circulation, $789,000; bonds for deposits, $175,000; total, including other items, $3,617,757 88. The following were the chief liabilities: capital stock, $1,200,000; surplus and undivided profits, $344,287 28; circulation, $673,102; individual deposits, $1,081,196 02. There are 15 or 20 state banks.—There were 32 m. of railroad in operation in 1854, 451 in 1862, and 711 in 1870. The following table contains the particulars of the different lines for 1875:

| LINES. | TERMINI. FROM | TERMINI. TO | Miles in operation in the state. |
|---|---|---|---|
| Galveston, Harrisburg, and San Antonio | Harrisburg (on the Galveston, Houston, and Henderson) | Luling, Caldwell co. | 155 |
| Galveston, Houston, and Henderson | Galveston | Houston | 50 |
| Gulf, Western Texas, and Pacific | Indianola | Cuero, De Witt co. | 70 |
| Houston and Great Northern* | Houston | Palestine (on the International) | 152 |
| Huntsville branch | Phelps | Huntsville | 8 |
| Columbia division | Houston | Columbia, Brazoria co. | 50 |
| Northern division | Troupe (on the International) | Mineola (on the Texas and Pacific) | 44 |
| Houston and Texas Central | Houston | Red River City | 341 |
| Western division | Hempstead | Austin | 114 |
| Waco branch | Bremond | Waco | 45 |
| International* | Longview (on the Texas and Pacific) | Rockdale, Milam co. | 205 |
| Texas and New Orleans | Houston | West Liberty, Liberty co. | 85 |
| Texas and Pacific | Shreveport, La. | Eagle Ford, Dallas co. (192 m.) | 172 |
| Branch | Marshall | Texarkana (just across the Arkansas border) | 75 |
| Transcontinental division | Sherman (on the Houston and Texas Central) | Brookston, Lamar co. | 56 |
| Total | | | 1,572 |

The Galveston, Harrisburg, and San Antonio railroad is in progress (1876) toward San Antonio, and the extension of the Gulf, Western Texas, and Pacific railroad to that city is contemplated. The Houston and Texas Central railroad connects at Red River City with the Missouri, Kansas, and Texas railroad for St. Louis. The International railroad is intended to extend S. W. to Laredo on the Rio Grande. The Texas and Pacific railroad has permission by its charter to continue its line across the continent to San Diego, Cal.; the Transcontinental division, when completed, will extend from Texarkana to Fort Worth. Tarrant co., on the main line. The Texas and New Orleans railroad was in operation to the Sabine river previous to the civil war, during which it was nearly destroyed; it is to be repaired. The Galveston and Santa Fé railroad has been chartered to connect those two points, and 40 m. are in course of construction from Galveston. The Texas Western railroad (narrow gauge), from Houston to San Antonio, is in progress W. from Houston.—A new constitution was adopted by vote of the people, Feb. 15, 1876, which was to go into effect on the third Tuesday in April following. The executive officers are a governor (annual salary, $4,000), lieutenant governor, secretary of state ($2,000), comptroller of public accounts ($2,500), treasurer ($2,500), commissioner of the general land office ($2,500), and attorney general ($2,000, besides fees not exceeding $2,000). They hold office for two years, and are all elected by the qualified voters, except the secretary of state, who is appointed by the governor and senate. The lieutenant governor is *ex officio* president of the senate, and in that capacity receives the pay of a senator. The legislature consists of a senate of 31 members, elected by districts, and a house of representatives of 93 members, distributed among the counties. At the apportionment in 1880 the number of representatives may be increased to not more than 150. The representatives are elected biennially; the senators hold office four years, one half being elected biennially. The sessions are biennial. Two thirds of each house are necessary to a quorum, and a two-thirds vote is necessary to overcome the governor's veto. Members of the legislature receive not more than $5 for each day's attendance, and not more than $5 for each 25 miles' travel to and from the capital. The judicial authority is vested in a supreme court, a court of appeals, district courts, county courts, and justices of the peace (inferior cases). The supreme court consists of a chief justice and two associates, and has appellate jurisdiction of civil cases of which the district courts have original or appellate jurisdiction. The court of appeals consists of three judges, and has appellate jurisdiction of criminal cases, and of civil cases of which the county courts have original or appellate jurisdiction. The judges of the supreme court and court of appeals are elected by the qualified voters for six years, and receive an annual salary of $3,550 each. A district court is held twice a year in each county, having original jurisdiction of felonies, divorce, land titles, &c., and of civil cases involving $500 and upward, and appellate jurisdiction of probate cases from the county courts. A district judge (annual salary, $2,500; term, four years) is elected by the qualified voters of each of the 26 judicial districts. A county judge is elected by the qualified voters of each county for two years. The county courts have original jurisdiction of misdemeanors, probate cases, and civil cases involving from $200 to $1,000, and appellate jurisdiction of judgments of justices of the peace. The right of suffrage is conferred upon every male citizen of the United States, or person who has declared his intention to become such, of sound mind and not a pauper or convict, who has attained the age of 21 years and has resided one year in the state and six months in the county or district. Elections are by ballot. In elections in cities and corporate towns to determine expenditure of money or assumption of debt only taxpayers may vote. Gen-

* Consolidated as the International and Great Northern.

eral elections are held biennially on the Tuesday next after the first Monday of November in even years (commencing with 1878). Amendments to the constitution must be proposed by two thirds of each house of the legislature, and approved by a majority of the people. Texas is entitled to six representatives and two senators in congress, and therefore has eight votes in the electoral college.—The valuation of property, according to the United States censuses, has been as follows:

| YEARS. | ASSESSED VALUE. | | | True value of real and personal estate. |
|---|---|---|---|---|
| | Real estate. | Personal estate. | Total. | |
| 1850 .. | ............ | ............ | ............ | $52,740,473 |
| 1860 .. | $112,476,013 | $155,316,322 | $267,792,335 | 365,200,614 |
| 1870 .. | 97,186,568 | 52,546,361 | 149,732,929 | 159,052,542 |

The decrease from 1860 to 1870 was due to the civil war, and particularly to the emancipation of the slaves. The assessed value of property in 1874 was $241,841,860; in 1875 it was believed that with a proper system of assessment it would amount to $300,000,000. The taxation of 1873 amounted to $2,517,394, of which $1,286,188 ($168,254 on polls and $1,117,934 on property) was state and $1,231,206 county. The estimated receipts during the year ending Aug. 31, 1876, available for the general expenses of the state, are $1,289,348; available for school purposes, $715,129 70; total, $2,004,477 70, of which $1,400,130 are from taxes on property, $279,000 from occupation tax, $170,347 70 from poll taxes, $125,000 from interest on permanent school fund, and $30,000 from office fees. The appropriations for the same period are as follows: for executive departments, $182,230; judicial department, $256,625; school department, $505,400, including $500,000 for teachers' wages; blind asylum, $16,120; deaf and dumb asylum, $14,000; lunatic asylum, $38,300; penitentiary, $40,000; interest, $480,000; frontier defence, $150,000; other purposes, $5,610; total, $1,688,285. The bonded debt on Aug. 31, 1875, amounted to $4,107,588; floating debt, $614,326 36; total, $4,721,914 36. Besides this there was a debt of doubtful validity, amounting to $829,687 66, and consisting of bonds issued by the state to the school and university funds, with accrued interest thereon.—The state institutions are the penitentiary, at Huntsville, and the institution for the deaf and dumb (opened in 1857), the institute for the blind (1856), and the lunatic asylum (1861), at Austin. The labor of the convicts is leased to contractors. The number registered at the penitentiary in November, 1875, was 1,686, of whom 452 were employed at the penitentiary and the rest elsewhere. The institution for the deaf and dumb in 1874 had 46 pupils (31 males and 15 females); the blind institute, 40 (16 males and 24 females); and the lunatic asylum, 127 inmates (68 males and 59 females). In 1875 an act was passed providing for the erection of two additional penitentiaries, one N. E. of the Trinity river and the other W. of the Colorado river.—The governor, comptroller, and secretary of state constitute a board of education. The public schools are regulated by an act of 1873, with amendments. In each county a board of five school directors is elected for four years; these choose one of their number president, who is *ex officio* county superintendent of public instruction. In each school district three trustees are elected annually. Cities may assume control of the schools within their limits, subject to the general school law. The schools for white and colored children are separate. Under the provisions of the constitution one fourth of the revenue from general taxation and a poll tax of $1 on males between 21 and 60 years of age, together with the interest on the permanent school fund, are annually set apart for the support of public schools; there is also a landed endowment, consisting of 60,314,000 acres of the public domain. In 1874 there were 2,129 public schools, with 98,308 pupils enrolled, out of a school population (6 to 18 years) of 313,061; private schools, 132, with 4,381 pupils; public school houses, 1,007; amount of state school fund apportioned, $499,930 50; teachers' wages, $612,878 67. Only 77 counties reported the number of pupils enrolled in the public schools; the number enrolled in the entire state was estimated by the superintendent of public instruction at 161,670. The permanent school fund on Aug. 31, 1875, amounted to $2,637,673 31. Under acts of congress of 1862 and 1866, the state received a donation of 180,000 acres of land scrip for the establishment of an agricultural and mechanical college. This was sold in 1871, and the proceeds were invested in 7 per cent. gold bonds of the state ($174,000). Buildings have been erected by the state near Bryan. The following table gives particulars of collegiate institutions for 1874–'5:

| INSTITUTIONS. | Location. | Denomination. | Date of organization. | Number of instructors. | Number of students. |
|---|---|---|---|---|---|
| Baylor university.......... | Independence................ | Baptist...................... | 1845 | 7* | 80 |
| Austin college............ | Huntsville.................. | Presbyterian................ | 1850 | 4 | ... |
| University of St. Mary..... | Galveston................... | Roman Catholic............ | 1854 | 10 | 163 |
| Soule university........... | Chappell Hill, Washington co.. | Methodist Episcopal, South. | 1856 | .. | ... |
| Waco university........... | Waco........................ | Baptist...................... | 1857 | 14 | 291 |
| Salado college............. | Salado, Bell co.............. | Non-sectarian............... | 1869 | 5 | 204 |
| Trinity university......... | Tehuacana, Limestone co..... | Cumberland Presbyterian... | 1869 | 18 | 408 |
| Henderson college......... | Henderson, Rusk co.......... | Non-sectarian............... | 1871 | 6 | 200 |
| Texas university........... | Georgetown, Williamson co... | Methodist Episcopal, South.. | 1874 | 6 | 68 |

These institutions, besides the ordinary college course, have preparatory and inferior departments, which embrace the greater part of the students. Several of them admit both sexes. A law department has been organized in Trinity university. The American dental college at Austin, organized in 1873, and the Galveston medical college, founded in 1864, have each six professors. The Barnes institute, at Galveston, Coronal institute at San Marcos, Hays co., St. Mary's Catholic institute, at San Antonio, and the Texas military institute, at Austin, are important. Among female seminaries are the Andrew female college, at Huntsville; Baylor female college, at Independence; Bryan female seminary, Brazos co.; Chappell Hill female college; Lamar female college, at Paris, Lamar co.; Ursuline academy, at Galveston; and Waco female college. The state has set apart 1,221,000 acres of land for the establishment of a university, but no steps have yet been taken to found the institution. There were also in the treasury on Aug. 31, 1874, bonds to the amount of $134,472 26 belonging to the university fund.—The number of libraries returned by the census of 1870 was 455, with an aggregate of 87,111 volumes, of which 135, with 25,018 volumes, were other than private, including 131 Sunday school libraries, with 19,318 volumes. There were 112 newspapers and periodicals, issuing 4,214,800 copies annually and having a circulation of 55,250, viz.: 12 daily, circulation 3,500; 5 tri-weekly, 2,450; 5 semi-weekly, 3,700; 89 weekly, 45,300; and 1 semi-monthly, 300. The following are the statistics of churches, according to the census:

| DENOMINATIONS. | Organizations. | Edifices. | Sittings. | Property. |
|---|---|---|---|---|
| Baptist | 275 | 211 | 61,700 | $196,540 |
| Christian | 18 | 17 | 4,450 | 11,650 |
| Congregational | 1 | 1 | 500 | 5,000 |
| Episcopal | 32 | 31 | 11,400 | 109,400 |
| Jewish | 1 | 1 | 400 | 6,000 |
| Lutheran | 23 | 21 | 7,650 | 47,900 |
| Methodist | 355 | 244 | 69,100 | 251,140 |
| Presbyterian, regular | 86 | 70 | 22,750 | 128,500 |
| " other | 15 | 14 | 4,850 | 14,100 |
| Roman Catholic | 86 | 36 | 16,000 | 264,200 |
| Union | 1 | 1 | 300 | 1,000 |
| Total | 843 | 647 | 199,100 | $1,035,430 |

—In 1685 a colony of French emigrants led by the sieur de La Salle, designing to found a settlement in the delta of the Mississippi, sailed past it unawares, landed in Matagorda bay, and erected Fort St. Louis on the Lavaca. In 1689 Capt. De Leon, a Spanish officer, was despatched to the Lavaca to scour the country and hunt out the French. He arrived there on April 22, found the garrison scattered, and returned the next year with 110 men and some friars, and established on the site of Fort St. Louis the mission of San Francisco. In 1691 a Spanish governor of the region was appointed, and soldiers were sent to enforce his authority; but in 1693 the hostility of the Indians, the failure of the crops, and the death of their cattle discouraged the colonists, and the settlements were abandoned. The Spaniards had settlements at El Paso and at San Juan Bautista, both on the right bank of the Rio Grande, but none within the present bounds of Texas. In 1714 the French again attempted to effect a settlement within its limits, and Crozat, to whom Louis XIV. had granted the whole of Louisiana, sent Huchereau Saint-Denis upon an expedition thither. He penetrated from the Sabine to the Rio Grande, and visited the Spanish mission of San Juan, where he was taken prisoner by the governor of Coahuila; but having subsequently married the daughter of the commandant of that mission, he introduced Spanish missionaries into Texas, who established a mission on the bay of San Bernardo or Matagorda, another west of the Sabine and near the coast (the famous mission of Dolores), and a third on the right bank of the San Pedro, near San Antonio, subsequently removed eastward, and known as the Alamo. Two other missions were established soon after, one near Nacogdoches, the other not far from San Augustine. The name of "the New Philippines" was now given to the country, and in 1715 the marquis de Aguayo was made governor general of the colony. For 20 years the Spaniards held sole sway, and multiplied their settlements. In 1735 Saint-Denis, who had acquired great influence over the Texas Indians, aided in removing a French settlement on Red river into Texas; the Spaniards protested, but owing to quarrels among themselves did not drive them out, and finally conceded that they had a right to the region they were occupying. In 1758 the Indians attacked the mission of San Saba, and killed all its inhabitants. This caused the decline of the missions in Texas, as the slaughter was never avenged; in 1765 there were not more than 750 European inhabitants, with about the same number of domiciled Indians. In 1762–'3 the feud between France and Spain was finally settled by the cession of the vast Louisiana territory by the former power to the latter. In 1803, Spain having re-ceded Louisiana to France, that power sold it to the United States; and as there had been no well defined boundary between Louisiana and the old Spanish possessions W. of it, a controversy at once ensued between Spain and the United States on the question of boundaries, Spain claiming a region E. of the Sabine, and the United States urging that they were entitled to the country W. as far as the Rio Grande. In October, 1806, Gen. Herrera, the Spanish commander, entered into an agreement with Gen. Wilkinson establishing the territory between the Sabine and Arroyo Honda as a neutral ground, and retired W. of that line. At this time the population of Texas was about 7,000, many of the settlers being adventurers engaged in illicit trade between the United States and Mexico. From 1806 a series of revolutionary efforts com-

menced, beginning with the projected movement of Aaron Burr, and embracing the expeditions of Magee, a former lieutenant of the U. S. army; of Col. Kemper, his successor; of Bernardo Gutierrez; of Col. Ellis P. Bean, who had suffered a protracted and cruel imprisonment from the Spanish authorities; of Gen. J. A. Toledo, a Cuban republican; of Col. Perry, an American officer; of Auzy, who styled himself governor of Texas; and of Xavier Mina, a Spanish refugee, who aided in the capture of Galveston island in 1816. In these expeditions there were several severe battles fought between the invaders and the Spanish authorities; on two occasions in 1813, the invaders defeated the Spanish forces, and caused them a loss of more than 1,000. In the same year, of a force of 2,500 Americans and Mexicans, all were slain but about 100, a considerable number being butchered in cold blood, and nearly 700 of the peaceable inhabitants of San Antonio murdered. In 1817 Mina won several victories in conflict with the Spanish troops, but was finally defeated, taken prisoner, and shot on Nov. 11 of that year. After the close of the war of 1812 Lafitte, the pirate of the gulf, made Galveston island his headquarters, and established a town there named Campeachy. He remained here till 1821, when a naval force was despatched by the United States government to break up the settlement. In 1819 the long controversy between the United States and Spain in regard to the Texan boundary was terminated by the establishment of the Sabine as the boundary line. This treaty occasioned much dissatisfaction on the part of the western and southwestern states. Mr. Clay and other prominent men opposed it. A revolutionary expedition was organized at Natchez the same year, under the command of Dr. James Long, a Tennesseean, which penetrated as far as Nacogdoches and established a provisional government there, and the leader went to Galveston island to secure the coöperation of Lafitte; but while he was absent his force was routed and cut to pieces by the royalist troops. In a second expedition Long took possession of La Bahia without difficulty; but, though Mexico had become independent under Iturbide, he and his followers were taken prisoners and sent to the city of Mexico, where after a brief imprisonment he was set at liberty, but was almost immediately assassinated, in 1822. Texas at this time was almost wholly deserted, the settlement at Galveston entirely abandoned, and the few inhabitants at other points reduced to poverty by the civil war. In 1820 Moses Austin, then residing in Missouri, received from the Spanish authorities of Mexico a grant of lands in Texas. He died before he was able to avail himself of it, and his son, Stephen F. Austin, received a confirmation of the grant in 1823, having already in the beginning of 1822 conducted a considerable number of colonists to the site he had selected in the vicinity of the present county of Austin. The colony increased rapidly, and Austin obtained permission to bring in 500 more families (his first grant was for 300). Others also followed in the establishment of colonies in the same vicinity. The Mexican constitution, adopted in 1824, united Coahuila, hitherto a separate province, with Texas in a single state, and the congress of the united state placed a Mexican as commandant of the department of Texas. The injustice of this commandant toward the American citizens, especially those attached to the colony of Hayden Edwards, created difficulty; and an appeal being made to the governor of the state, who was also a Mexican, he without trial or examination annulled Edwards's grant and ordered his expulsion from the state. Edwards and his colonists attempted unsuccessfully to effect a revolution; and in January, 1827, they were compelled to retreat into the United States. In 1830 Bustamante, who had seized the dictatorship of Mexico, issued a decree forbidding the people of the United States to enter Texas as colonists, and suspending all colony contracts which interfered with this prohibition. In 1832 the Texans sustained the *pronunciamiento* of Vera Cruz in favor of the constitution, and in opposition to the rule of Bustamante, and defeated a force under Col. Piedras, who favored the dictator. In 1833 the American settlers, now numbering over 20,000, held a convention, determined to separate themselves from Coahuila, and prepared a state constitution and an address to the general government, of which Santa Anna was now the head, requesting admission as a separate state into the republic. Col. S. F. Austin went to Mexico to present the request of the memorialists. He was unsuccessful, and was detained in Mexico till September, 1835, but in 1834 procured the revocation of the decree of Bustamante prohibiting the admission of colonists from the United States, and several other favorable concessions. Santa Anna sought to amuse Austin and the Texans with promises of allowing them a separate state government till he could occupy the country with his troops. The government of the state of Coahuila and Texas having been overthrown, committees of safety were established, the first being appointed at a meeting at Mina (now Bastrop), May 17, 1835. The first battle, or rather skirmish, was fought near Gonzales, Oct. 2. Other battles followed. Goliad was captured by the Texans on Oct. 9, and the battle of Concepcion, near San Antonio, was fought on the 28th. On Nov. 3 the "Consultation," a body composed of delegates from the municipalities, met at San Felipe de Austin, and proceeded to the organization of a provisional government. Henry Smith was elected governor and J. W. Robinson lieutenant governor, and a general council was organized. At the same time Sam Houston was elected commander-in-chief, and Austin

was appointed a commissioner to the United States. San Antonio de Bexar was taken on Dec. 10, after being cannonaded for six days. By this victory the entire armed Mexican force was driven out of Texas. On the 20th a "Declaration of Independence" was issued at Goliad by Capt. Philip Dimitt and others there. Santa Anna set out with an army of 7,500 men, well provided with artillery, ammunition, and stores. On Feb. 23, 1836, he invested the Alamo, a strong fort near San Antonio, which was garrisoned at this time by 140 men under command of W. B. Travis, and 32 more subsequently forced their way through the Mexicans into it. Santa Anna with 4,000 men bombarded it for 11 days, and finally carried it by storm. On March 6 the whole garrison were put to the sword, and but three persons, a woman, a child, and a servant, were spared. The Mexican loss was 1,600. On March 1 a convention assembled at Washington on the Brazos, and on the 2d issued a declaration of independence; on the 16th a provisional president (David G. Burnet) and other officers were elected, and a constitution was adopted, which was signed on the 17th. Meanwhile Gen. Houston found it necessary on the approach of Santa Anna to evacuate Gonzales. The tragedy of the Alamo, the murder of Col. Fannin's command in cold blood at Goliad, March 27, 1836, by Santa Anna's order, in violation of the terms of surrender (see FANNIN, JAMES W.), and the successive defeats of the Texan troops, produced a temporary panic. This was increased by the continued retreat of Gen. Houston, who fell back first to the Colorado, then to the Brazos, and finally to the San Jacinto, his design being to scatter and divide the Mexican force, in which he was eminently successful. The alarm soon passed away, and having collected a force of about 800 troops, he gave battle on April 21 to the Mexican forces which had pursued them, of about twice the number, and defeated them completely, killing 630, wounding 208, and taking 730 prisoners; among the latter (though not captured till the next day) was the Mexican president, who had commanded in person. The Mexicans were at once demoralized, and retreated rapidly westward in disorder. Santa Anna was held a prisoner, but the war was practically ended; and though the Mexican government made several attempts to fit out other armies to reconquer Texas, and refused to acknowledge its independence, their forces did not again invade the country. Gen. Houston, who had been wounded in the battle of San Jacinto, and had resigned his command of the army, was elected president in September, 1836, and on Oct. 22 was inaugurated. The first congress of the republic assembled about the same time, the constitution having been adopted in the election of September. In March, 1837, the United States acknowledged the independence of Texas. In 1838 Mirabeau B. Lamar succeeded Gen. Houston as president. Repeated incursions were made by the Comanches and other Indian tribes; and in 1840 the Texans pursued them after one of their forays, penetrated into their country, and inflicted summary and severe punishment. In 1839 the independence of the republic was acknowledged by France, and in 1840 by England, Holland, and Belgium. But while thus recognized by leading powers as independent, her financial condition was every month becoming more deplorable. In September, 1841, Gen. Houston was again elected president. In 1841 and 1842 the Mexican government sent several marauding expeditions into Texas, and in the latter year San Antonio was twice captured and plundered. The Texans attempted reprisals by two ill-judged expeditions, neither under the direction of the government, the first in 1841 to Santa Fé, the second in 1842 to Mier in the state of Tamaulipas. Both were unsuccessful, and many of the Texans were taken prisoners by the Mexicans and executed. In the spring of 1843 a third expedition, intended to intercept the Mexican traders to Santa Fé, was fitted out by private parties, but with the approbation of the government, which also proved a failure. The same year, on the remonstrance of the British chargé d'affaires to Mexico, Santa Anna informed Gen. Houston that he would agree to an armistice, and commissioners were appointed. While the negotiations were pending, President Tyler made propositions to the president of Texas for her annexation to the United States, which after a time were favorably received, and a treaty was made looking to annexation. This treaty was completed and signed by the Texan commissioners and Mr. Calhoun, secretary of state, April 12, 1844; but was rejected by the United States senate on June 8. The agitation of this subject greatly irritated Mexico, and caused her to terminate the armistice and threaten the renewal of hostilities; it also displeased Great Britain and France, who desired to see Texas under an English or joint protectorate, without slavery, and free from the influence of the United States. In December, 1844, Dr. Anson Jones was inaugurated president of the republic. Its revenues were now increasing, and its population growing with great rapidity, and the threats of war from Mexico were rendered powerless by her weakness and dissensions. The only disturbances within the boundaries of Texas were the conflicts between the "regulators" and the "moderators" in Shelby and adjacent counties. These were finally put down by armed force. Joint resolutions providing for the annexation of Texas passed the United States house of representatives by a vote of 120 to 98, Jan 25, 1845, and the senate by a vote of 27 to 25 on Feb. 27, with an amendment, which was concurred in by the house the next day by a vote of 132 to 76. On March 1 these resolutions were approved by President Tyler.

President Jones called a convention of 61 delegates to meet on July 4 to consider the propositions for annexation, and that convention ratified the act and prepared a constitution for the republic as a state of the federal Union, which was submitted to the people and approved by them. On Dec. 29 a joint resolution of congress declared Texas admitted into the Union as a state. Its annexation led to a war with Mexico, which terminated in 1848. (See Mexico.) Under the Spaniards Texas was bounded W. by the Nueces and N. by Red river, but at the time of its annexation the republic claimed as its W. boundary the Rio Grande and a line running N. from the source of that stream to the 42d parallel, making its area 376,133 sq. m. In 1850 the state ceded to the United States its claim to all territory beyond its present limits, in consideration of $10,000,000 in bonds, with the proceeds of which the state debt was paid. At the presidential election in 1860, 47,548 votes were cast for the Breckinridge electors, and 15,438 for the Bell electors. As soon as the election of Lincoln became known, the secessionists began to urge the governor (Sam Houston) to call an extra session of the legislature, which he for some time refused to do. Finally, the secessionists having called an irregular convention, the governor assembled the legislature on Jan. 21, 1861, which sanctioned the convention thus called. The convention met on Jan. 28, and on Feb. 1 adopted an ordinance of secession by a vote of 166 to 7, which on Feb. 23 was ratified by the people by a vote of 34,794 to 11,235. The governor having neglected to take the oath of allegiance to the confederacy, as required by the convention, an ordinance was passed on March 16 declaring his seat vacant, which action was confirmed by the legislature on the 20th. The permanent constitution of the Confederate States was ratified on March 23 by a vote of 68 to 2. In the mean time, on Feb. 18, Gen. Twiggs, in command of the United States forces in Texas, surrendered his entire command and all the military posts and munitions of war to the state authorities. No very important military operations occurred in the state during the war. Galveston was occupied by a federal force on Oct. 8, 1862, but it was retaken by the confederates on Jan. 1, 1863. On Oct. 26 Gen. Banks set out from New Orleans with an expedition under the immediate command of Gen. Dana, and landed at Brazos Santiago on Nov. 2. Brownsville was entered on the 16th, and other points in western Texas were occupied. The last fight of the war took place in western Texas on May 13, 1865, between a federal force under Col. Barret and a confederate force under Gen. Slaughter, the latter being victorious. On the 26th Gen. Kirby Smith surrendered the last confederate army. On July 21 Gen. A. J. Hamilton, appointed provisional governor by President Johnson, arrived at Galveston. An election was held on Jan. 8, 1866, for delegates to a state convention, those being entitled to vote who were qualified according to the laws in force prior to secession, and who had taken the amnesty oath prescribed by the president's proclamation of May 29, 1865. The convention met on Feb. 10 and adjourned on April 25, having adopted amendments to the constitution declaring the ordinance of secession void, abolishing slavery, and repudiating the war debt. At an election held in June these amendments were ratified, and J. W. Throckmorton was chosen governor. On Aug. 13 he entered upon his duties. Under the reconstruction acts of 1867 Texas with Louisiana was constituted the fifth military district under Maj. Gen. Sheridan, and was placed in immediate command of Brev. Maj. Gen. Charles Griffin. Gen. Sheridan assumed command March 19, 1867. On July 30 Gov. Throckmorton was removed, and E. M. Pease appointed in his place. Several changes of military commanders subsequently took place. On a registration, 59,633 white and 49,497 colored voters were enrolled. At an election in February, 1868, a convention was called, which assembled on June 1 and remained in session till Aug. 31, when it took a recess. Reassembling on Dec. 7, it adopted a constitution, and adjourned in February, 1869. At an election held Nov. 30 to Dec. 3, 1869, the constitution was ratified by a vote of 72,366 to 4,928, and E. J. Davis, republican, was chosen governor over A. J. Hamilton, conservative republican. The legislature elected at the same time assembled on Feb. 8, 1870, and ratified the 14th and 15th amendments to the constitution of the United States. On March 30 an act was passed readmitting the state to representation in congress, and on April 16 the government was turned over to the civil authorities. Within the last few years Texas has suffered severely from Indian incursions on the N. W. frontier and Mexican raids on the Rio Grande.

**TEXAS**, a S. county of Missouri, drained by Current river and affluents of the Gasconade; area, 1,250 sq. m.; pop. in 1870, 9,618, of whom 95 were colored. The surface is hilly, with large forests of yellow pine, and the soil fertile along the streams. The chief productions in 1870 were 51,778 bushels of wheat, 256,252 of Indian corn, 29,876 of oats, 16,318 of potatoes, 44,349 lbs. of tobacco, 13,238 of wool, 67,231 of butter, and 601 tons of hay. There were 2,061 horses, 2,399 milch cows, 4,424 other cattle, 7,393 sheep, 15,284 swine, and 6 saw mills. Capital, Houston.

**TEXEL**, an island of the Netherlands, in the North sea, province of North Holland, separated from the mainland by the channel called Mars Diep, about 2 m. broad; extreme length 14 m., breadth 6 m.; area, 74 sq. m.; pop. in 1869, 6,145. It contains several villages, the most important of which is Burg. The surface is low and a great deal of it marshy, but it is protected from inundations by the line of

dunes or sand hills on the W. side, and strong dikes in other parts. The soil is remarkably fertile, and is chiefly occupied by pastures.

**TEXIER, Charles Félix Marie**, a French archæologist, born in Versailles, Aug. 29, 1802. He studied architecture at the school of fine arts in Paris, was employed for ten years in explorations in the East under the patronage of the government, and was afterward inspector of public buildings in France and Algeria. His works, remarkable for learning and magnificent illustrations, include *Description de l'Arménie, de la Perse et de la Mésopotamie* (2 vols. fol., Paris, 1842–'5); *Description de l'Asie Mineure* (4 vols., 1839 *et seq.*, and simultaneously in English by R. P. Pullan); *Édesse et ses monuments en Mésopotamie* (1859); and in conjunction with Pullan, "Byzantine Architecture" (London, 1864), and "The Principal Ruins of Asia Minor" (1865).

**TEZCUCO, or Tezcoco**, a town of Mexico, in the state and about 16 m. E. N. E. of the city of Mexico, near the E. shore of the lake of the same name; pop. about 5,000. It contains several handsome buildings, public and private. Woollen and cotton goods are manufactured. In ancient times Tezcuco was the second city in Mexico. One of the palaces of Montezuma is said to have stood in the N. W. quarter, and in the S. part there are massive remains of three pyramids, each measuring 400 ft. along the base of their fronts.

**THACHER, James**, an American physician, born in Barnstable, Mass., Feb. 14, 1754, died in Plymouth, May 26, 1844. On the breaking out of the revolution he was appointed surgeon's mate to Dr. John Warren in the general hospital at Cambridge; in 1778 he was made chief surgeon to the first Virginia state regiment, and in 1779 was transferred to a New England regiment. In March, 1783, he settled as a physician at Plymouth, Mass., where he also gave some attention to the manufacture of salt and iron. He published "The American New Dispensatory" (Boston, 1810), which was long a standard work on pharmacy, medical chemistry, and materia medica; "Observations on Hydrophobia" (1812); "The Modern Practice of Physic" (1817; 2d ed., 1826); "The American Orchardist" (1822; 2d ed., 1825); "A Military Journal during the Revolutionary War" (1823; 3d ed., Hartford, 1854); "American Medical Biography" (2 vols. 8vo, 1828); "A Practical Treatise on the Management of Bees" (1829); "An Essay on Demonology, Ghosts, Apparitions, and Popular Superstitions" (1831); and "History of the Town of Plymouth" (1832; 2d ed., 1835).

**THACHER, Peter**, an American clergyman, born in Milton, Mass., March 21, 1752, died in Savannah, Ga., Dec. 16, 1802. He graduated at Harvard college in 1769, and settled at Malden, Mass., in 1770. He soon attained a high reputation as a preacher, and received the name of the "silver-tongued Thacher." From January, 1785, till his death, he was pastor of the Brattle street church in Boston. His "Oration against Standing Armies," delivered at Watertown in 1776, still retains its reputation. For 15 years he was chaplain of one or both branches of the legislature. He published 22 distinct works, including "Observations on the State of the Clergy in New England" 1783), and "Memoirs of Dr. Boylston" (1789).

**THACKERAY, William Makepeace**, an English author, born in Calcutta in 1811, died in London, Dec. 24, 1863. He was descended from an old Yorkshire family. His father was in the civil service of the East India company. He was educated at the Charterhouse in London, and at Cambridge, but did not take a degree. Coming into possession of £20,000 at the age of 21, he travelled on the continent, and studied art for several years. But he lost the bulk of his fortune by speculation, and about the age of 30 adopted literature as a profession. He wrote for "Fraser's Magazine" under the pseudonymes of Michael Angelo Titmarsh and George Fitz-Boodle, and contributed to "Punch" three series of papers: "The Fat Contributor," "Jeames's Diary," and "The Snob Papers." These and other works appeared in book form from 1840 to 1848, but he attained no very marked success in literature till the publication of "Vanity Fair, a Novel without a Hero," in monthly numbers, in 1846–'8. This gave him a reputation as a novelist which, though amply sustained, was hardly increased by any of his later works. In 1845 he visited the East for his health. He was called to the bar in 1848, but did not practise. In 1851 he delivered to brilliant audiences in London a series of lectures on "English Humorists of the Eighteenth Century." He visited America in 1852, and again in 1855–'6, where he repeated this course, and also delivered for the first time another course on "The Four Georges," which he repeated in the principal cities of Great Britain. In 1857 he was an unsuccessful candidate, as a liberal, for the representation of the city of Oxford in parliament. The "Cornhill Magazine" was commenced at the close of 1859 with Thackeray as editor, and quickly attained an enormous circulation. He resigned the editorship in April, 1862. He was found dead in his bed, from effusion on the brain. He was buried in Kensal Green cemetery. A bust of him, by Marochetti, was unveiled in Westminster abbey, Oct. 21, 1865. He was tall and powerfully built, with a massive head and silvery white hair. His geniality, even temper, and kindly disposition toward everybody with whom he came into personal relations, were curiously at variance with the charge of cynicism so often brought against his works. His domestic life was clouded for several years by the insanity of his wife. His novels and tales, with the dates of their publication in book form, are: "The Great Hoggarty Diamond" (1841); "The Memoirs of Barry Lyndon" (1843); "Vanity Fair" (1848);

"The History of Pendennis" (1850); "The History of Henry Esmond" (1852); "The Newcomes" (1855); "The Virginians" (1859); "Lovel the Widower" (1860); "The Adventures of Philip on his Way through the World" (1862); and "Denis Duval," left unfinished (1864). His Christmas books are: "Mrs. Perkins's Ball" (1846); "Our Street" (1848); "Dr. Birch and his Young Friends" (1849); "Rebecca and Rowena" (1850); "The Kickleburys on the Rhine" (1851); and "The Rose and the Ring" (1854). His other publications include "The Paris Sketch Book" (1840); "Comic Tales and Sketches" (2 vols., 1841); "The Second Funeral of Napoleon" and "The Chronicle of the Drum," in verse (published together, 1841); "The Irish Sketch Book" (2 vols., 1843); "Notes of a Journey from Cornhill to Grand Cairo" (1846); "The Book of Snobs" (1848); "English Humorists of the Eighteenth Century" (1853); "Ballads" (1855); "The Four Georges" (1860); "Roundabout Papers" (1862); and "The Orphan of Pimlico, and other Sketches, Fragments, and Drawings," with notes by his daughter (1875). Most of his books were illustrated by himself. James T. Fields has made a collection of his fugitive articles, under the title "Early and Late Papers" (12mo, Boston, 1867). There are numerous approximately complete editions of Thackeray's works, the latest of which reproduces the original illustrations (22 vols., London, 1875 *et seq.*).—See "Studies on Thackeray," by James Hannay, and "Thackeray, the Humorist and the Man of Letters: the Story of his Life," by Theodore Taylor (London, 1864).—His daughter ANNE ISABELLA has published "The Story of Elizabeth" (London, 1863; German translation, Leipsic, 1864; Dutch, Amsterdam, 1864); "The Village on the Cliff" (1867); "Old Kensington" (1873); "Toilers and Spinsters, and other Essays" (1873); "Bluebeard's Keys" (1874); "Miss Angel," a novel founded on the life of Angelica Kauffmann (1876); and numerous short tales and sketches.

**THAER, Albrecht**, a German agricultural writer, born in Celle, May 14, 1752, died at Mögelin, near Potsdam, Oct. 26, 1828. He studied at Göttingen, and in 1780 was appointed court physician at Hanover. In 1790 he established an agricultural school at Celle, in 1804 entered the Prussian civil service, and in 1807 erected on his estate of Mögelin an institution since known as the royal school of agriculture. In 1810 he was appointed professor of agriculture and political economy in the university of Berlin, with a seat in the ministry of the interior. In 1815 he became superintendent of the royal establishments for breeding sheep. His great work, *Grundsätze der rationellen Landwirthschaft* (4 vols., Berlin, 1809; 6th ed., 1868), has been translated into English by W. Shaw and C. W. Johnson ("The Principles of Agriculture," 2 vols., London, 1844; 1 vol., New York, 1849), and into other languages. Among his other works are: *Einleitung zur Kenntniss der englischen Landwirthschaft* (3 vols., Hanover, 1798–1804; 3d ed., 1816); *Ueber die feinwollige Schafzucht* (Berlin, 1811); and *Leitfaden zur allgemeinen landwirthschaftlichen Gewerbslehre* (1816). A monument was erected to him at Leipsic, Sept. 28, 1850, and one designed by Rauch at Berlin, Nov. 15, 1860.—See *Albrecht Thaer*, by Wilhelm Körte (Leipsic, 1839).

**THAIS**, an Athenian courtesan, who accompanied Alexander the Great on his expedition to Asia. She is said to have instigated him to set fire to the citadel of Persepolis, the residence of the Persian kings, in revenge for the injuries done to her native city by Xerxes; but this is probably untrue, as we know on the authority of Arrian that it was his intention to sack the place and burn the citadel on grounds of state policy. After the death of Alexander, Thais became the mistress of Ptolemy Soter, and, according to Athenæus, was afterward married to him. She was celebrated for wit and repartee.

**THALBERG, Sigismond**, a Swiss pianist, born in Geneva, Jan. 7, 1812, died in Naples, April 27, 1871. He was the natural son of Prince Dietrichstein, and was placed under the instruction of Hummel, whom he subsequently surpassed in firmness of touch and grace of expression. At 15 he began to be known in the concert rooms, and soon afterward published his first compositions. From 1830 to 1839 he made extended concert tours through Europe, appearing in England in 1837. He visited South America and the United States in 1856–'8. His playing was distinguished by precision, delicacy, and finish, rather than by the production of surprising effects; but his chief merit, both as a performer and a composer, consisted in his successful attempts to combine the elements of song and harmony and of brilliant execution, as exemplified respectively in the schools of Mozart and Beethoven and of Clementi. In pursuance of this design he discovered many ingenious combinations for the fingers, whereby the song or melody, which he kept in the medium keys of the piano, could always be heard strongly accented in the midst of rapid passages, scales, arpeggios running from end to end of the instrument, and other complicated forms of accompaniment. This species of composition has since become exceedingly common, through the works of a host of imitators. Among the productions by which Thalberg and his method acquired their celebrity are a series of fantasias of great beauty and brilliancy, including those on themes from *Don Giovanni*, *Robert le Diable*, *L'Elisire d'amore*, *Les Huguenots*, *La donna del lago*, and *Mose en Egitto*, the performance of any one of which by the composer realized the perfection of pianoforte playing. In 1851 he produced at London under Balfe's direction an opera entitled *Florinda*, founded on a libretto by Scribe, which failed to attract much attention.

In 1845 he married a daughter of Lablache. His last public appearance was at Paris in 1865. After that he retired to his estate near Naples, where he devoted himself to the cultivation of the vine.—His daughter ZAIRE, born in New York in 1858, made a successful début as Zerlina in *Don Giovanni*, at Covent Garden, London, April 10, 1875.

**THALER** (Dan. and Swed. *daler*), a coin and money of account of Germany, Austria, Holland, Belgium, Denmark, Sweden, and Norway. Silver coins of an ounce weight were struck in the early part of the 16th century at Joachimsthal, a town in Bohemia, whence the name. (See DOLLAR.) Other countries after a time began to coin thalers, but not always of the same value, and hence originated the *Laubthaler* or leaf dollar, the *Philippsthaler*, the Swedish copper dollar, &c. In most of the countries of Europe the royal or imperial mints coined thalers, hence called *rigsdaler*, *riksdaler*, or *Reichsthaler*, that is, dollar of the realm. These varied in value according to the amount of alloy. (See COINS.) As money of account there is still greater diversity of values, owing to the depreciation of the issues of the national banks or treasuries. In Sweden the *rigsdaler riksmynt*, now the authorized money of account, is about 27 cts. In Denmark the *rigsbank daler* is about 54 cts. In Germany generally the *thaler* of account is reckoned at 69 to 73 cts. American currency.

**THALES**, a Greek philosopher, and one of the seven wise men, born in Miletus, Ionia, about 636 B. C., died probably about 546. He took an active part in the political affairs of his native country. He visited Crete and Egypt, and acquired in the latter country an acquaintance with geometry. Various physical discoveries are attributed to him. He measured the height of the Egyptian pyramids by observation of the time at which a shadow equalled in length the height of the object; and he is said to have computed the sun's orbit, to have fixed the length of the year at 365 days, and to have been the first among the Greeks to predict eclipses, though very vaguely. Aristotle calls him the originator of the Ionic natural philosophy, and hence, indirectly, of Greek philosophy in general. He taught that all things are instinct with life, and originate from water. The writings attributed to him were declared spurious in antiquity, and his sayings recorded by Aristotle and Diogenes Laërtius are probably conjectural.

**THALIA**, in Greek mythology, the muse of comedy and idyllic poetry. She is generally represented with a mask in one hand and a shepherd's staff or a wreath of ivy in the other.

**THALLIUM** (Gr. θαλλός, a green bough), one of the three metals forming the class of triads, the others being iridium and gold. It was discovered by Crookes of London in 1861, in the seleniferous residue from the manufacture of sulphuric acid from iron pyrites. Its discovery resulted from the observation by Mr. Crookes of a green band in the spectrum of the vaporized portion of the residue. It is widely diffused as a constituent of iron and copper pyrites, but forms only about the 4,000th part of the mass. It also exists in the lepidolite of Moravia, in mica from Zinnwald in Bohemia, in the mother liquors of the salt works at Nauheim, and in the mineral crookesite from Skrikerum in Norway. It is most economically prepared from the flue dust of pyrites burners. This dust is stirred with boiling water in wooden tubs, and the decanted or syphoned liquor treated with an excess of strong hydrochloric acid, by which impure monochloride of thallium is precipitated. This impure chloride is then treated with hot oil of vitriol, and contaminations of other metals are separated by sulphuretted hydrogen. A pure sulphate is obtained, from which the metal may be separated by electrolysis or the action of zinc. Thallium resembles cadmium in color, but approaches lead in specific gravity, having a density of 11·8 to 11·91, according to its metallurgic treatment. The symbol of thallium is Tl; its atomic weight, according to recent extended researches by its discoverer, is 203·642. (See "Chemical News," London, 1874.) It has a highly crystalline structure, and crackles like tin when bent, but is easily hammered into leaves. It melts at 561° F. A polished piece of the metal tarnishes rapidly when exposed to the air, but the action continues only a short time, as the thin film of oxide protects it from further oxidation. The metal and its compounds impart an intense green color to colorless flames, which when viewed by the spectroscope is found to be monochromatic, appearing as a sharply defined green band. It forms numerous compounds, including three oxides, the most important being thallous oxide, $Tl_2O$; this dissolves readily in water, producing a caustic alkaline solution which absorbs carbonic acid from the air. The sulphate forms with aluminic sulphate an octahedral alum. The salts of thallium are poisonous. The metal has been used to render glass highly refractive.

**THAMES**, a river of Connecticut, formed by the junction of the Quinebaug (with its branch the Shetucket) and Yantic rivers at the city of Norwich, and flowing thence S. about 15 m. to Long Island sound, which it enters below New London. It is wide and beautiful, navigable for large vessels to Norwich, and has an excellent harbor at its mouth. The streams which form it possess numerous valuable mill sites, and the large amount of manufactured goods from the factories on their banks make the Thames an important avenue of commerce.

**THAMES**, a river of Ontario, Canada, flowing through a fertile country in the peninsula formed by Lakes Huron and Erie, and after a S. W. course of about 160 m. discharging into Lake St. Clair. It is navigable for small vessels from its mouth to Chatham, 18 m. The city of London is the most important place on its banks.—At the Moravian settlement on this

river, Oct. 5, 1813, the battle of the Thames was fought between the British under Gen. Proctor, with an auxiliary force of 2,000 Indians led by Tecumseh, and the Americans under Gen. W. H. Harrison. The American cavalry, commanded by Col. Richard M. Johnson, opened the battle, and defeated the enemy. Tecumseh was killed, and 600 prisoners, six pieces of cannon, and large quantities of stores were taken by the Americans.

**THAMES,** or **Isis** (anc. *Tamesis* or *Tamesa*), the largest and most important river of England. Its source, called Thames Head, is in the Cotswold hills, about 3 m. S. W. of Cirencester, 376 ft. above the sea level. In the first 30 m. of its course it receives the Churnet, the Coln, and the Lech, and below Lechlade becomes navigable for barges; from Lechlade its course is first E. and then N. N. E. and S. S. E. to Oxford, through a level country, the river receiving on its way the Windrush and the Cherwell. Flowing generally S. S. E. from Oxford to Reading, it receives the Thame and the Kennet; thence making a considerable circuit to the north by Henley, Great Marlow, and Maidenhead, it turns eastward to Windsor, then makes a detour southeastward by Staines and Chertsey to Kingston, where it turns N., and, passing Richmond, reaches Brentford, whence its course is nearly due E. to its mouth. From Brentford it passes by Putney, Hammersmith, and Chelsea to London, receiving in its course the Loddon, Colne, Mole, Cran, Brent, and Wandle, all small streams. From London to its mouth, nearly 60 m., the Thames is navigable for vessels of 700 or 800 tons, and for vessels of any burden to Deptford, 3 m. S. E. of London bridge. It is about 300 yards wide at London bridge; at Woolwich, 9 m. below, 500 yards; at Coalhouse point, 20 m. further down, 1,300 yards; at the Nore, 6 m.; and at its mouth, 18 m. Below London it receives the Ravensbourne, Roding, Darent, and Medway. Its tide is perceptible as far as Teddington, 72 m. above its mouth. The Thames and Severn canal connects it with the Severn; the Oxford canal with the grand canal system of the central counties; the Wilts and Berks and the Kennet and Avon canals with the Avon and the Severn; the Wey and Arun and the Basingstoke canals with the Sussex coast; the Grand Junction, the Regent's, and the Paddington canals connect the Brent with the Oxford canal, and encircle the N. and E. sides of the metropolis. The whole course of the Thames is about 220 m. Its commerce is surpassed probably by that of no river in the world. Its docks are described in the article Dock. It is crossed at and above London by numerous bridges, and several tunnels pass under it. For a description of the bridges, the tunnels, and the new Thames embankments, see London, vol. x., pp. 592 and 617.

**THAN, Móricz,** a Hungarian painter, born at Old Becse in 1828. After studying law at Pesth, he devoted himself to painting at the academy of Vienna, and spent some time in Paris, where in 1855 he painted the battle of Mohács. He resided for a time at Rome, receiving instruction from Cornelius and Overbeck, and then settled in Pesth. His works include "Angelica and Medor," "The Tragedy of Mankind," fine altarpieces and frescoes, and the "Love of Fata Morgana," which figured at the Paris exhibition of 1867.

**THANET, Isle of,** an island of England, on the N. coast of Kent, separated from the mainland by branches of the river Stour called the Stourwantsome, the Mele-stream, and the Nethergong-wantsome; length 10 m., breadth 5 m.; area, about 40 sq. m.; pop. in 1871, 30,134. The most important towns are the watering places Ramsgate, Margate, and Broadstairs. The N. E. point of the island is called the North Foreland, and has a lighthouse. The surface, elevated and nearly level, is cultivated with great care. In the time of the Romans the channel on the N. W. side, now almost closed, was from 1½ to 4 m. wide, and was used as the main passage for vessels going toward London; and it continued to be navigable for vessels of considerable size till the time of the Norman conquest. The island was then nearly circular, but it is now an irregular oval. The washing away is still going on, and the average annual loss is estimated at 2 ft. on the N. side, and 3 ft. on the S. side between Ramsgate and Pegwell bay.

**THANKSGIVING DAY,** an annual religious festival, observed in the United States, and particularly in New England, suggested by the Hebrew feast of tabernacles, or "feast of ingathering at the end of the year." The occasional observance of a day of thanksgiving, formally recommended by the civil authorities, was not unusual in Europe, and such a day was observed in Leyden, Holland, Oct. 3, 1575, the first anniversary of the deliverance of that city from siege. In 1608 the Pilgrim church, exiled from England, went to Holland, and remained there till 1620, when it sent off the Mayflower colony to New England. After the first harvest of the colonists at Plymouth in 1621, Gov. Bradford sent four men out fowling, that they "might after a more special manner rejoice together." In July, 1623, a day of fasting and prayer was appointed on account of drought. Rain came abundantly while they were praying, and the governor appointed a day of thanksgiving, which was observed with religious services. The Charlestown records show a similar change of fast day into thanksgiving in 1631 on account of the arrival of supplies from Ireland. In June, 1632, Gov. Winthrop, of the Massachusetts Bay colony, recommended a day of thanksgiving on account of action of the British privy council favorable to the colonies, and invited the governor of Plymouth colony to unite with him. There is record of the official appointment of days of thanksgiving in Massachusetts Bay in 1633, 1634, 1637, 1638, and

1639, sometimes of more than one day in the same year, and in Plymouth in 1651, 1668, 1680 (when the form of the recommendation indicates that it had become an annual custom), 1689, and 1690. The earlier of these appointments were at different seasons of the year, and for special reasons, particularly for the arrival of ships with provisions and new colonists; but the later were more generally for the harvest, and were in the late autumn or early winter. Occasional thanksgiving days were appointed by the Dutch governors of New Netherland in 1644, 1645, 1655, and 1664, and by the English governors of New York in 1755 and 1760. During the revolution thanksgiving day was a national institution, being annually recommended by congress; but after the general thanksgiving for peace in 1784 there was no national appointment till 1789, when President Washington, by request of congress, recommended a day of thanksgiving for the adoption of the constitution. Washington issued a second thanksgiving proclamation in 1795 on account of the suppression of insurrection. President Madison, by request of congress, recommended thanksgiving for peace in April, 1815. But the official recommendation of thanksgiving day was mainly confined to New England, where regular annual proclamations were issued by the governors of the states, and the day was observed almost universally with religious services, and was the principal social and home festival of the year. The prayer book of the Protestant Episcopal church, ratified in 1789, recommends for a day of thanksgiving the first Thursday in November, unless another day be appointed by the civil authorities. There was occasional recommendation by other religious bodies, and various local customs prevailed in different parts of the country; but the day was not regularly recommended by the governor of New York till 1817, and its adoption in the southern states was much later. In 1855 Gov. Johnson of Virginia recommended a day of thanksgiving; but in 1857 Gov. Wise, being requested to do so, publicly declined, because unauthorized to interfere in religious matters. In 1858 thanksgiving proclamations were issued by the governors of eight of the southern states. During the civil war President Lincoln issued proclamations recommending special thanksgiving for victory in 1862 and 1863, and a national proclamation of the annual thanksgiving day in 1863 and 1864. Since that time such a proclamation has been issued annually by the president, as well as by the governors of the states and the mayors of the principal cities; and custom has fixed the time for the last Thursday in November.

**THASOS** (now *Thasso*), the most northerly island of the Grecian archipelago, belonging to Turkey, lying off the S. coast of Roumelia (vilayet of Salonica), nearly circular in form; area, about 85 sq. m.; pop. about 6,000, mostly Greeks. The centre of the island is occupied by Mt. Ipsario, a summit about 3,500 ft. above the sea, and thickly covered with fir trees. The principal ancient town, bearing the same name, was upon three eminences near the N. coast, and some remains of it still exist. The soil is not fertile, and the inhabitants, scattered in about a dozen small villages, do not produce grain enough for their own consumption. The vine was formerly cultivated, and the wine of Thasos was celebrated, but little or none is now produced. In ancient times it contained also valuable gold mines, opened by the Phœnicians, and marble quarries.—Thasos was once of great importance. It was said to have been settled by the Phœnicians, led by Thasos, the son of Agenor, when in search of Europa. Toward the close of the 8th century B. C. it was colonized by settlers from Paros, who very soon became powerful, and obtained considerable possessions also on the coast of Thrace. The gold mines worked by the islanders were very productive, leaving them a clear surplus revenue of about $300,000 annually. They were subdued by the Persians, and afterward became dependent on the maritime empire of Athens; but in 465, in consequence of disputes, the Athenians subjugated and despoiled the island, after a siege of more than two years. Its subsequent history is one of almost constant conflict with Athens, to which it was nominally subject, until the time of the Roman wars, when it submitted to Philip V. of Macedon; but after the battle of Cynoscephalæ (197) it became a free state.

**THATCHER, Benjamin Bussey**, an American author, born in Warren, Me., Oct. 8, 1809, died in Boston, July 14, 1848. He graduated at Bowdoin college in 1826, and studied law, but devoted himself to literature. In 1836 he visited England for his health, and spent two years there. His published works are: "Biography of North American Indians who have been distinguished as Orators, Statesmen, Warriors," &c. (2 vols. 18mo, New York, 1832); "Memoir of Phillis Wheatley" (Boston, 1834); "Traits of the Boston Tea Party" (1835); "Traits of Indian Manners, Character," &c. (2 vols. 18mo, 1835); and "Tales of the American Revolution" (1846).

**THAYER**, a S. E. county of Nebraska, bordering on Kansas, formed since 1870; area, 576 sq. m.; pop. in 1875, 2,139. It is intersected by the Little Blue river and Big Sandy creek, and is crossed in the N. part by the St. Joseph and Denver City railroad. It has an undulating prairie surface and a fertile soil. Capital, Hebron.

**THEATINES**, an order of regular clerks, founded at Rome in 1524 by Gaetano di Tiene (died in 1547; canonized by Clement X.), Bonifazio di Colle, Giovanni Pietro Caraffa (afterward Pope Paul IV.), and Paolo Consigliari. Gaetano and Bonifazio were the first who united to form a society of priests following the rules of apostolic life as set down in the New Tes-

tament; hence its members were popularly known as Cajetans (*Gaetani*). But the extension and establishment of the order were mainly due to Caraffa, who was archbishop of Chieti (Lat. *Theate*) when he was received by Gaetano as his associate, and thus gave the order its official name. It was approved in 1524 by Clement VII., under the designation of "regular clerks," the dress of the members being that of the secular clergy. Caraffa had been elected superior general. Their first residence on Monte Pincio was sacked by the Spaniards May 6, 1527, and Gaetano was subjected to the most cruel tortures to make him give up the riches he was thought to possess. He soon after retired to Venice with his companions, and was chosen superior, and he and they displayed extraordinary charity during the plague and famine of 1528. They were afterward united with the congregation of Somascha, founded about this time in a town of that name near Bergamo by St. Girolamo Emiliano. The two congregations were separated on the elevation of Caraffa to the papal chair, May 23, 1555. In 1547 they had only two establishments, one at Venice and another at Naples. Through the influence of Paul IV. they spread rapidly, and soon possessed four provinces in Italy, one in Germany, one in Spain, two establishments in Poland, one in Portugal, and one in Goa. In France they had only the Parisian residence, which produced several remarkable men. They also founded missions in Tartary, Tiflis, and Circassia. At the beginning of the present century the Theatines did not exist outside of Italy, where they had nine establishments. These were all suppressed in 1870.—There were also two communities of Theatine nuns (one a congregation of hermits), both founded by Ursula Benincasa, the one in 1583, the other in 1610. Neither had ever more than two establishments, and both are now extinct.

**THEATRE** (Gr. *θέατρον*, a seeing place, from *θεᾶσθαι*, to view), a building in which plays are represented. The first theatres of the Greeks, who were the founders of the drama in our sense of the word (see DRAMA), were exceedingly rude affairs. Thespis is said to have acted his plays in a wagon, and in the time of Æschylus the performances took place upon temporary wooden scaffolds, one of which having broken down during a representation in which Æschylus and Pratinas were rivals (about 500 B. C.), the Athenians in that year began to build the great theatre of Dionysus (Bacchus), the first permanent stone structure of the kind. It was probably used for dramatic purposes within a few years, though it was not finished until about 340; and in the mean time theatres had been erected in many parts of Greece, Asia Minor, and Sicily. The seats of the spectators, comprising the *θέατρον* proper, rose one above another in arcs of concentric circles, each row forming nearly two thirds of a circumference. The space immediately in front of the spectators, corresponding nearly to the modern pit or parquet, was called the orchestra, and was appropriated to the chorus. It was floored with boards, and in the centre of it stood the *θυμέλη* or altar of Bacchus, upon a raised platform which was sometimes occupied by the leader of the chorus, the police, the flute player, and the prompter; the last two were placed on the side next the stage, and concealed from the spectators by the altar. The stage was behind the orchestra and above it, and the chorus, whenever they had to take a part in the real action of the drama, ascended to it by steps. The back was closed by a wall called the *σκηνή* (Lat. *scena*); the whole space between the scena and the orchestra was known as the proscenium; and the part nearest the audience, where the actors stood when they spoke, was the *λογεῖον*. There was no scenery properly so called, but the scena was architecturally decorated and made to represent as far as possible the locality in which the action was going on. It had an entrance in the centre called the royal door, through which the principal characters made their appearance, and doors on the right and left for the subordinate personages. The plays of Æschylus and Euripides seem to require frequent changes of scene, but probably they were rather hinted at than actually made; they perhaps consisted merely in turning the *περίακτοι* (Lat. *versuræ*) or "wings," which were prism-shaped frames moving on pivots at each side of the proscenium. The whole stage was never concealed from the spectators; there is mention of a curtain, which instead of being drawn up was lowered through a crevice in the stage, but it covered only the background, or according to some authorities the wings. The machines for producing supernatural effects must have been numerous and elaborate, but are now imperfectly understood. They included the "Charonian steps," by which shades ascended from the lower world; the *μηχανή*, by which gods and heroes were represented passing through the air; and the *θεολογεῖον*, an elevated place above the scena, where the deities appeared in full majesty. Neither the stage, the orchestra, nor the auditorium was roofed, but there were porticoes running around the building, to which the people retreated in case of rain, and awnings were sometimes used to ward off the heat of the sun, for the performances always took place by daylight. The vast size of the ancient theatres, intended as they were to accommodate almost the entire population of a city at each performance, made it impossible for the unaided voice to be heard by the whole audience. Metallic vases were therefore placed under the seats to serve as reflectors of sound, and the actors wore masks with metallic mouthpieces to answer the purpose of speaking trumpets. The spectators were seated according to their rank. A price was charged for admission, at least until the performance was pretty far advanced; but in Athens from the time of Pericles the poorer class and subsequently all the

citizens were admitted at the cost of the public treasury. Women, it appears, were allowed to witness tragedies, but were excluded from comedies; boys were admitted to both. The actors were invariably males. The performances began early in the morning, and not unfrequently lasted 10 or 12 hours.—The Roman theatres were copied from those of the Italian Greeks. They were at first temporary structures of wood, which were sometimes extravagantly magnificent. One built by M. Æmilius Scaurus (58 B. C.) was capable of seating 80,000 people, and the scena was decorated with 3,000 statues and 360 columns in three stories, the lowest of white marble, the middle one of glass, and the uppermost of gilded wood. The first stone theatre was pulled down when nearly finished at the instance of P. Scipio Nasica (155 B. C.), on the score of public morality. In the Roman theatre women performed in interludes and mimics, but not in regular dramas. The orchestra was occupied by the senators, foreign ambassadors, and other distinguished persons. There was nothing corresponding to the θυμέλη or altar of Bacchus. The depth of the stage was proportionally greater than in the Greek theatre, being in the latter about one seventh of the diameter of the orchestra, and in the Roman one fourth. Thus, in the theatre of Bacchus at Athens the diameter of the orchestra (and consequently the width of the available part of the stage) was 72 ft., and the depth of the stage only a little more than 10 ft. A Roman stage of the same width would have been 17½ ft. deep. The following are some of the largest ancient theatres the ruins of which are now known:

| LOCATION. | General diameter, feet. | Diameter of orchestra, feet. |
|---|---|---|
| Ephesus | 660 | 240 |
| Tralles | 540 | 150 |
| Rome (theatre of Marcellus) | 517 | 172 |
| Miletus | 474 | 224 |
| Sparta | 453 | 217 |
| Syracuse | 440 | .... |
| Aspendus | 400 | 25 rows of seats |
| Cnidus | 400 | .... |
| Phellus | 400 | Width of scena, 150 |

—In the middle ages the only theatrical performances were the miracle plays, mysteries, and interludes. These were given for the most part in convents, colleges, and churches, or in the halls of palaces and castles. The first theatres in France were built for miracle plays. In 1548 the confraternity of the Trinity had a theatre in Paris in which they were licensed by the parliament to perform only "profane pieces of a lawful and honest character." So late as 1561 the French had no scenery, and the performers remained on the stage during the whole representation. The first Italian theatre is said to have been erected at Florence in 1581, by Bernardo Buontalenti, but it was probably not public. About the same time Palladio made an attempt to revive the classical theatre in the still existing *teatro Olimpico* at Vicenza, but with reduced proportions. From 1618, when a theatre was built at Parma by Aleotti, the modern arrangement began to prevail. By narrowing the stage opportunity was given for the use of painted scenery, and by increasing its depth for the introduction of a variety of complicated machines and the production of spectacular pieces.—In England there were regular companies of players as early as the reign of Edward IV., long before there were regular play houses. Churches, universities, private houses, and the yards of inns served at first for their performances. Probably the first play house was the London "Theatre," built before 1576; the Curtain in Shoreditch, and the theatres in Blackfriars and Whitefriars, were built near the same time. In Shakespeare's day London had three "private" and four "public" theatres, the difference between which is not clearly understood. His own plays were produced at the house in Blackfriars and at the Globe, both of which belonged to the same company, known as his majesty's servants. The Globe was a hexagonal wooden edifice, partly open at the top and partly thatched. In the middle was probably an uncovered court where the common people stood, and around three sides ran galleries or "scaffolds," under the lowest of which were enclosed boxes called "rooms." The prices of admission ranged from a penny or twopence to a shilling. The performance began at 3 o'clock; in the private theatres it took place by candle light. The stage at this period was strewed with rushes and concealed by curtains, which opened in the middle and drew backward and forward on an iron rod. In the background was a balcony or upper stage, likewise curtained, from which parts of the dialogue were spoken, and at each side of this balcony was a private box. In the private theatres the wits, critics, and other persons of consequence were furnished with seats on the stage. Movable scenery was first used in a regular drama in a public theatre by Davenant in 1662, though something of the sort had been arranged at Oxford by Inigo Jones as early as 1605, on the occasion of an entertainment given to James I. Shakespeare had no other scenery than tapestry hangings and curtains, but the use of stage machinery is as old as the drama itself. Women first appeared upon the English stage about the period of the restoration.—The first theatre in America was opened at Williamsburg, Va., Sept. 5, 1752. Others followed at Annapolis, Md., and in Nassau street, New York (1753), Albany (1769), Baltimore (1773), Charleston, S. C. (1774), Newbern, N. C. (1788), and Boston (1792). The largest in the United States are the opera houses of New York, New Orleans, Cincinnati, Philadelphia, and Brooklyn, and the Boston theatre. Modern theatres, except those intended for opera, are comparatively small. It has been found that the voice, moderately exerted, can be distinctly

heard about 90 ft. in front of the speaker, and 75 ft. each side. In an opera house the dimensions may be vastly increased, as singing can be heard at a greater distance than speaking, and it is not requisite to bring the audience near enough to see the facial expression of the performers. The theatres of New York are among the best in the world, and the seating arrangements of American theatres generally are more convenient than in foreign theatres. The opera houses and leading theatres in the United States are described in the articles devoted to the different cities. The best form for the auditorium is either three fourths of a circle, or a semicircle with divergent ends. The latter affords the best opportunities for seeing, but involves either a disproportionate and inconvenient width of stage, or a considerable useless space on each side of the proscenium. Most American theatres differ from those of Europe in having no private boxes, except a few on and adjoining the proscenium, by which means a vast gain is effected in the capacity of the house; they are also generally better lighted.—The largest and finest theatre in the world is the new Grand Opera of Paris. It was begun in 1860, and opened to the public for the first time on Jan. 5, 1875. It was built at the expense of the government, and cost $5,600,000, exclusive of the land which it occupies. Notwithstanding the vast size of the building, the auditorium contains only 2,194 seats, or about the same as the academies of music in New York and Brooklyn. By far the greater part of the building is occupied by a vast number of rooms, halls, staircases, shops, &c., appurtenances designed for the convenience and pleasure of the spectators and of those connected with the theatre. The stage is about 100 ft. in width by 220 ft. in depth, and 700 singers can be grouped upon it. In its facilities for ingress and egress, in the completeness of its machinery and appliances, and in the magnificence and costliness of its decorations, it far surpasses any theatre of modern times. The following are some of the largest theatres in the world, with the number of spectators they are capable of accommodating:

| | |
|---|---|
| London, New Pavilion, Whitechapel | 3,700 |
| " Drury Lane | 3,500 |
| " Her Majesty's, Haymarket | 2,500 |
| " Italian opera, Covent Garden | 2,000 |
| Milan, La Scala | 3,600 |
| Naples, San Carlo | 3,600 |
| Boston theatre | 3,400 |
| Venice, La Fenice | 3,000 |
| St. Petersburg, Bolshoi theatre | 3,000 |
| Philadelphia, academy of music | 2,850 |
| Turin, theatre royal | 2,500 |
| Florence, La Pergola | 2,500 |
| Munich, royal theatre | 2,500 |
| Brooklyn, academy of music | 2,243 |
| New York, academy of music (burned in 1866, and rebuilt smaller) | 2,160 |
| Paris, Grand Opéra | 2,194 |
| " Ambigu comique | 1,900 |
| " Porte St. Martin | 1,800 |
| " Théâtre Italien | 1,700 |
| " Théâtre Lyrique | 1,700 |
| " Odéon | 1,650 |
| " Opéra comique | 1,500 |

—In China every little village has its theatre, and each great town has several. They have no scenery and no auditorium, the spectators remaining in the open air. The expenses are defrayed sometimes by mandarins or other rich persons, but more frequently by associations formed for the purpose among the inhabitants of the neighborhood. The actors are generally strollers, and the female parts are played by young men or boys. In Japan the stage has scenery, the audience are furnished with seats, and women are allowed to perform.

**THEBAIS**, the ancient name of southern or Upper Egypt, from its capital Thebes. This division of the country extended from the islands of Elephantine and Philæ, near Syene (lat. 24° N.), to Thebaica Phylace, S. of Hermopolis Magna (about 27° 40′ N.).

**THEBES** (called No or No-Ammon by the Hebrews, and Diospolis the Great by the later Greeks and the Romans), anciently the capital of Upper Egypt, and for a long time, known as the period of the middle empire, of the whole country. Its Egyptian name was Ap, or Apé, and with the feminine article Tape, the head, which, being pronounced Thaba in the Memphitic dialect, was easily converted by the Greeks into Θῆβαι (Thebæ). Pliny and Juvenal, desiring to render its real name more closely, call it Thebe. From the fact that the names of the oldest kings appear only about Memphis, it is generally inferred that Thebes was not founded as early as the capital of Lower Egypt, though in antiquity it was reputed to be the oldest city in the world. It stood near the centre of the Thebaid, extending on both sides of the Nile to the mountain chains which enclose the valley. Strabo speaks of the vestiges of the city as extending 80 stadia (10 m.) in length. Diodorus estimated its circuit at 140 stadia or about 17 m., and Sir Gardner Wilkinson infers from its ruins that its length was 5¼ m. and its breadth 3 m. Its most flourishing period was that of the 18th dynasty; it began to decline about 800 B. C. (See EGYPT, vol. vi., p. 460.) Asshur-bani-pal pillaged it in the 7th century, and Cambyses in the 6th. After its destruction by Ptolemy Lathyrus (86 B. C.), it lost all its political and commercial importance, though it remained the sacerdotal capital of the worshippers of Ammon. The trade which had contributed to its prosperity had found new channels after the foundation of Alexandria; and as the capital of a Macedonian and Roman prefecture it took little part in the affairs of Egypt. It was desolated successively by Christians of the Thebaid, in their zeal against idolatrous monuments, by barbarians from Arabia and Nubia, and by the Saracens; after whose invasion its name scarcely occurs for many centuries.—The ruins of Thebes, which are among the most magnificent in the world, are found at the modern villages of Luxor and Karnak on the E. bank of the Nile, and Gurna and Medinet-Abu on the western. The eastern quarter of the ancient city contained the mass

of the population, while the western side was covered with temples and palaces and their avenues of sphinxes, and with the rock-hewn tombs of the kings. The principal structures at Gurna are the palace temples Mernephtheum and Ramesseum. The former, approached by an avenue 128 ft. long, has pillars in the oldest style of Egyptian architecture and remarkable bass-reliefs. The latter, which for symmetry of architecture and elegance of sculpture may vie with any other Egyptian monument, occupies a series of terraces communicating with each other by flights of steps. It is supposed to be the Memnonium of Strabo, and that he corrupted Miamun, the title of Rameses II., into Memnon. Its entrance is flanked by two pyramidal towers; its first court has a double avenue of columns on either side, and in the area a pedestal on which was a syenite sitting colossus of Rameses; its second court has walls covered with sculptures representing the wars of Rameses III., and Osiride pillars which are doubtless the monolithal figures 16 cubits high described by Diodorus; the third stairway, from the foot of which Belzoni took the head of a royal statue of red granite, now in the British museum and known as the young Memnon, conducts to a hall for public assemblies, with columns and walls covered with civil and religious sculptures; and beyond the hall extended nine smaller apartments, two of which remain, supported by columns, one of them being the sacred library or "dispensary of the mind" mentioned by Diodorus. Among the other monuments in this vicinity are two colossal statues, with the pedestals about 60 ft. high, the wonder of the ancients, one of them known as the vocal Memnon. (See Memnon.) The village of Medinet-Abu stands upon a lofty mound formed by the ruins of the most splendid temple palace in western Thebes, the Thothmesium, connected with the palace of Rameses by a dromos 265 ft. long. The sculptures in the latter are of singular interest, being the only examples that have been found of the decoration of the private apartments of an Egyptian palace. The whole sweep of the Libyan hills, for the space of 5 m. and to the height of 300 ft. from Gurna to Medinet-Abu, is full of sepulchres, excavated in the native calcareous rock. This was the necropolis of the whole city, no tombs existing on the eastern side. The mummies are laid in rows by the side of or in tiers above each other, but never stand erect. The tombs of the lower classes are unsculptured, but abound in mummies of sacred animals. The royal sepulchres are in the valley of Bab el-Muluk, or Biban el-Muluk (the gate or gates of kings), the most spacious and highly adorned belonging to those monarchs who enjoyed a long reign. The tombs near the entrance of the gorge belong entirely to the 19th and 20th dynasties, and those in a branch path are of the 18th dynasty. The monuments, as also those in the separate burial place allotted to the queens, are chiefly interesting from their inscriptions.—Still more remarkable are the ruins on the E. bank of the river, in the villages of Luxor and Karnak. At Luxor the most striking monuments were

Gateway of the Temple of Luxor.

two beautiful obelisks of red granite, covered with inscriptions, one of which has been removed to the Place de la Concorde in Paris. In the rear are two sitting statues of Rameses,

Gateway of Karnak.

one 39 ft. high, but now covered to the breast with accumulations of earth and sand. Two courts and a series of apartments, connected and surrounded by colonnades and porticoes,

extend beyond. The road from Luxor to Karnak lies through fields of *halfa* grass, though they were once united by an avenue of androsphinxes. The great palace temple of Karnak stands within a circuit wall of brick, the enclosure being 1,800 ft. long and somewhat less broad. It was approached by an avenue of crio-sphinxes, of which only fragments remain. Between the end of the dromos and the main body of the building, five lofty pylones and four spacious courts intervene. In the first court were two obelisks of Thothmes I., one of which still remains; in the second court is another obelisk, the loftiest known except that of St. John Lateran at Rome; and in one of the chambers are the sculptures which compose the Karnak tablet, called the "hall of the ancestors" or the "tablet of Tuthmosis" (Thothmes III.), now in the Louvre. The king is represented on it as making offerings before the images of 61 of his predecessors. In the British museum is now a tablet of the same kind, known as the "tablet of Abydos." The great hall is 80 ft. high, 329 ft. long, and 179 ft. wide; the roof is supported by a central avenue of 12 massive columns, 66 ft. high and 12 ft. in diameter, together with 122 columns of less gigantic dimensions. These vast courts, halls, and esplanades were reared by kings of the 18th and succeeding dynasties for purposes partly religious and partly secular. The sacred calendar abounded in days for periodical meetings; the troops were reviewed and the spoils of victory apportioned in the courts of royal palaces, which also served for the administration of justice and occasionally for the encampment of the army.

**THEBES** (Gr. Θῆβαι; Lat. *Thebæ;* modern Gr. *Thiva*), in Greek antiquity, the chief city of Bœotia, built on and around a hill between the streams of Ismenus on the east and Dirce on the west. The citadel occupied the height, and the greater part of the town stood in the valleys. Of its ancient buildings, monuments, and walls, only a few scattered fragments remain, and its topography is entirely uncertain. It is impossible to harmonize the ancient writers as to the position or even the names of its seven gates. Thebes was equally illustrious in the mythical and the historical ages of Greece. Its two sieges and the fortunes of its royal houses were favorite subjects of tragedy; and it was for a time the ruling city of Greece. Tradition ascribed to Cadmus the foundation of the city, which was hence called Cadmea, a name afterward restricted to the citadel. From the five Sparti, the survivors of the progeny of the dragon's teeth, the noblest Theban families claimed descent. The expulsion of Œdipus, and the successive sieges by the "Seven against Thebes" and by the Epigoni, were the principal recorded events before the Cadmeans were driven out by the Bœotians, a tribe from Thessaly. This occurred about 60 years after the Trojan war, according to Thucydides. The legislation of Philolaus, in the 8th century B. C., gave it an oligarchical instead of monarchical form of government, and made it the head of the confederacy of Bœotian towns. The first entirely certain event in its history is the revolt of one of these towns, Platæa (about 519), which applied to Athens for protection. A war ensued between the Thebans and Athenians, in which the latter were successful, and which initiated lasting enmity between the two states. Thebes lost credit by abandoning the cause of Greece in the Persian war, and fighting against the Athenians at Platæa (479). The victorious Greeks appeared before its walls, and compelled the inhabitants to surrender their "Medizing" leaders, who were immediately put to death. An Athenian invasion supplanted its oligarchy by a democratic government in 456, but in 447 the exiled aristocratic leaders returned, defeated the Athenians, and reëstablished the former government. During the Peloponnesian war the Thebans were more anti-Athenian than even the Spartans, but they joined the coalition against the latter in 395, and were the only portion of the allied army which was not routed by them at Coronea. The peace of Antalcidas (387) deprived them of their supremacy over the other Bœotian towns. The Spartans, who treacherously seized the citadel in 382, were expelled by Pelopidas about the close of 379, and were defeated by Epaminondas at Leuctra in 371. Epaminondas invaded the Peloponnesus, and established there the Arcadian confederation and the state of Messenia as political powers antagonistic to Sparta. But the Thebans sought in vain to establish their supremacy by a general treaty, and lost it after the death of Epaminondas at Mantinea (362). In 358 Athens wrested Eubœa from Thebes. In the sacred war (357-346) the Thebans were opposed to Athens and Sparta, and received support from Philip of Macedon; but when the design of the latter to conquer the whole of Greece became apparent, they joined the Athenians against him. Philip, however, was victorious at Cheronæa (338). Thebes received a Macedonian garrison, and its leading citizens were put to death or banished. Alexander the Great razed it to the ground in 335, sparing only the house of Pindar, after which it never again formed an independent state. Cassander restored the city in 315, and it was taken by Demetrius Poliorcetes in 292 and 290. In the time of Strabo it had dwindled down to the condition of a village, but it was a flourishing town during the 10th and 11th centuries. It was plundered by the Normans of Sicily in 1146. The present town is small and poor.

**THEFT.** See Larceny.

**THEINE.** See Caffeine, and Tea.

**THEINER. I. Augustin**, a German historian, born in Breslau, April 11, 1804, died in Civitâ Vecchia, Aug. 9, 1874. He studied at Breslau and Halle, and from 1826 to 1828 assisted his brother Johann Anton in his work on the history of celibacy. An essay on the papal decre-

tals procured for him from the university of Halle the degree of doctor of laws, and from the Prussian government a stipend for a literary journey to Vienna, London, and Paris. In 1831 he visited Rome, and became a member of the oratory of St. Philip Neri, professing thenceforward an ultramontanism as extreme as had been his Gallicanism. He continued to reside in Rome, and was consultor of the holy office, of the congregation of bishops and regulars, and of the division of the propaganda on oriental rites. In 1848 he published *Lettere historico-critiche intorno alle "Cinque piaghe della santa chiesa" del chiarissimo D. Antonio Rosmini Serbati.* In this work Theiner denounced the election by laymen of bishops and parish priests, and maintained that the temporal sovereignty of the popes was "indispensable, under the modern formation of society, to the spiritual independence of the supreme pastor of the church." It was translated into Latin (Naples, 1849). Being appointed prefect or keeper of the secret archives of the Vatican in 1851, he issued in succession various compilations therefrom illustrating the ecclesiastical history of nearly all the different Christian nations. Six folio works were printed in the Vatican. He also began in 1856 a continuation of the *Annales Ecclesiastici* of Baronius, of which 3 vols. fol. have appeared, and an edition of the original work to consist of about 60 vols. 4to, of which 15 had appeared in 1868 (Bar-le-Duc). In 1853, in answer to Crétineau-Joly's history of the suppression of the Jesuits, he published *Geschichte des Pontificats Clemens XIV.* (2 vols., Leipsic and Paris), which led to a long and bitter pamphlet controversy. In 1861 he began a documentary history of the pope's temporal dominion, extending from 756 to 1793, entitled *Codex Diplomaticus Dominii temporalis Sanctæ Sedis* (3 vols. fol., Rome, 1861–'3). This was followed by a smaller work in 1864 destined to answer Passaglia's appeal to the Italian bishops, and maintaining the necessity of the temporal power from the declarations of the councils of Lyons (1245) and Constance. At the approach of the Vatican council in 1869, Theiner entered into a correspondence with Dr. Döllinger and Prof. Friedrich, in which he advocated the Old Catholic doctrine and position. The discovery of this caused him to be debarred all access to the archives, while, in consideration of his age, he was permitted to retain his salary and his apartment in the Vatican. In 1874 Theiner visited Austria to make arrangements for publishing another important literary work, and on his return to Italy died suddenly at the seaside, the pope having sent him his forgiveness and blessing on hearing of his danger. His other works include *Geschichte der geistlichen Bildungsanstalten* (Mentz, 1835); *Versuche des heiligen Stuhls die Völker des Nordens wiederum mit der Kirche zu vereinen* (Augsburg, 1837); and *Die neuesten Zustände der katholischen Kirche beider Ritus in Polen und Russland seit Katharina II.* (Augsburg, 1841). **II. Johann Anton**, a German theologian, elder brother of the preceding, born in Breslau, Dec. 15, 1799, died there, May 15, 1860. He studied Roman Catholic theology at Breslau, and was appointed there in 1824 professor of Scriptural exegesis and canon law. He was from the beginning a zealous advocate of Gallican principles, and eagerly sought to have them introduced and carried out among the clergy of Silesia. Assisted by his brother Augustin, he published in 1826 an extensive work on the history of celibacy (*Die Einführung der erzwungenen Ehelosigkeit*, Altenburg, 1828; new ed., 1845). He resigned his chair in 1830, and held a pastoral charge till 1845, when he joined the German Catholics, publishing in vindication of this step *Die reformatorischen Bestrebungen in der katholischen Kirche* (Altenburg, 1845); but soon afterward he joined the Protestant church, and received an appointment in the library of the university of Breslau. He wrote a commentary on the minor prophets, forming part of the *Bibelwerk* of Dereser, and *Das Seligkeitsdogma der römisch-katholischen Kirche* (Breslau, 1847).

**THEISS** (anc. *Tibiscus;* Hun. *Tisza*), a river of Hungary, which rises in the northeast, in the county of Mármaros, flows westward to Tokay, thence S. W. to Szolnok, when it turns S. and enters the Danube S. of Titel, near the southern boundary of Hungary. Its length is upward of 600 m., for most of which it is navigable. Its principal tributaries are the Bodrog, Hernád, Sajó, and Zagyva on the right, and the Szamos, Körös, and Maros on the left. Its lower course for nearly 300 m. is parallel to the Danube, and about the beginning of the present century the Francis canal was dug from one river to the other, which shortens the route down the Theiss and up the Danube 106 m. The canal has been enlarged, and a branch canal from Sztapár to Neusatz on the Danube, completed in 1875, passes through one of the most fertile districts in southern Hungary. Among the principal towns on the banks of the Theiss are Csongrád, Szegedin, Zenta, and Old Becse.

**THELWALL, John**, an English author, born in London, July 27, 1764, died in Bath, Feb. 17, 1834. In his 22d year he abandoned the profession of law for literature. In 1787 he published "Poems" (2 vols.); and embracing liberal opinions, he became a member of the "Corresponding Society." Taking a prominent part in the political agitation of the times, he was prosecuted for high treason along with John Horne Tooke and Thomas Hardy, and after a trial of five days was acquitted. He afterward lectured on political subjects, and in 1801 began to act as tutor of elocution. His works include "The Peripatetic" (3 vols. 12mo, 1793); "The Tribune" (3 vols. 8vo, 1796); "Poems, with Memoir of his Life" (1802); "The Daughter of Adoption," a novel; essays on the treatment of im-

perfections in speech, &c.—His son Algernon Sydney (1795–1863), a clergyman of the established church and teacher of elocution, published religious works, "Iniquities of the Opium Trade" (1839), &c.

**THEMIS,** in the Greek mythology, a daughter of Uranus and Gæa, married to Zeus. She dwelt in Olympus, and convened the assembly of the gods. She is represented in Homer as the personification of the order of things established by law, custom, and equity. At Thebes she had a sanctuary in common with Zeus Agoræus, and at Olympia in common with the Horæ, her daughters.

**THEMISTOCLES,** an Athenian general, born about 514 B. C., died in Magnesia, Asia Minor, about 449. He took part in the battle of Marathon in 490. After the exile of Aristides in 483 Themistocles was the great political leader in Athens. His main endeavor was to make Athens a great naval power, and to prepare it to resist the inroads of the Persians. In the beginning of 480, when the force of Xerxes was on the point of passing the Hellespont, he and the Spartan Euænetus were in command at the defile of Tempe, which they abandoned on finding that troops could be landed in their rear, retreating to their ships. Afterward he took charge of the Athenian portion of the fleet stationed at Artemisium. When the vast number of Persian ships was discovered, the Spartans were disposed to draw back to the Peloponnesus; but the Eubœans gave 30 talents to Themistocles, with which he induced them to remain and defend Eubœa. In the ensuing battle the Greeks had the advantage; but the Athenian ships being much crippled, it was determined to retire. (See Greece, vol. viii., p. 190.) At the instance of Themistocles the Athenians abandoned their city, and removed mainly to Salamis, where the whole naval force of Greece was gathered. It was only by his influence and devices that the fleet was kept together, and the naval battle was fought which resulted in a complete victory for the Greeks. The Athenians were desirous of pushing on to the Hellespont to prevent the retreat of Xerxes, but their confederates refused. Herodotus says that Themistocles privately sent word to the king that he had restrained the Greeks from pursuing his ships and breaking up his bridges over the Hellespont; and that he did this in order to induce Xerxes to return, and for the purpose of securing for himself a safe retreat in case any mischance should befall him at Athens. Modern historians consider this highly improbable. After the division of the booty gained at Salamis, the Greeks sailed to the isthmus, where Themistocles, though deprived of the first prize for skill and wisdom by each of the commanders voting for himself, was declared the wisest man in Greece, and the whole country was filled with his fame. He was received in Sparta with unprecedented honors; and though the Lacedæmonians gave to Eurybiades the crown of valor, they gave to Themistocles the crown of wisdom. When the Athenians returned to their city, the Spartans opposed their rebuilding their fortifications on an enlarged scale; but Themistocles was sent to them as ambassador, and he contrived to deceive them until the walls were far enough advanced to be in a state of defence. Athens was now secure against external enemies, and Themistocles was more than ever desirous of making her a great maritime power. The work on the Piræus was resumed on a far grander scale, and by his advice the three harbors were enclosed by a wall nearly seven miles in circuit. He also persuaded the Athenians to add 20 triremes to their navy every year. His political ascendancy soon declined. His opponents in Athens were headed by Cimon, son of Miltiades, and by Alcmæon. He was acquitted of treasonable intercourse with the Persians, but about 471 was ostracized and went into exile at Argos. According to some versions, Themistocles was accused by the Lacedæmonians of sharing the treasons of Pausanias; but he, having notice of his impending arrest, fled to Susa, where he addressed to Artaxerxes, the son of Xerxes, a letter claiming protection on the score of his services to his father after the battle of Salamis, and asking permission to wait a year and then to come before him in person to explain his views. His request was granted. At the end of a year, having mastered the Persian language, he entered into personal communication with the king; and no Greek, says Thucydides, had ever before attained such a commanding influence and position at the Persian court. He excited Artaxerxes with plans for the subjugation of Greece, and was presented by him with a Persian wife and with large presents. After having visited various parts of Asia, he lived at Magnesia on the Mæander, and received his maintenance from the revenues of that and two other cities. Some of his property at Athens was secretly sent him by his friends, but the bulk of it, amounting to 80 or 100 talents, was confiscated. He is said to have poisoned himself because he knew his promises to the Persian king could not be fulfilled. This is perhaps the most popular form of the story, of which other versions relate that the Persian king had set a price of 200 talents upon his head, that he went to Susa in the disguise of a stranger for the king's harem, and that he was actually put on trial to answer the accusations of Mandane, the sister of Xerxes, for the loss of her sons who fell at Salamis. We have no contemporary history of the life of Themistocles, and when Thucydides wrote his history his enemies had done their best to heighten prejudice against him. His life was written by Nepos and by Plutarch.

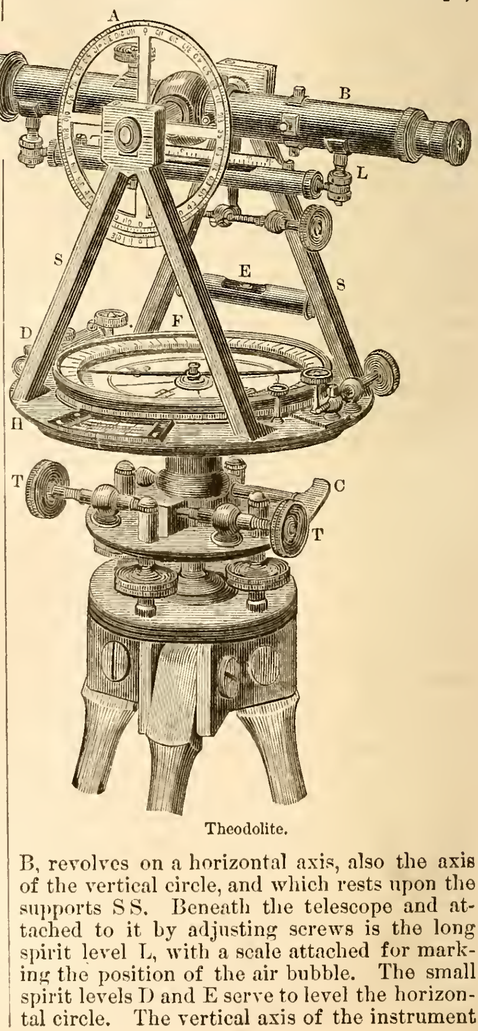
**THÉNARD, Louis Jacques,** baron, a French chemist, born at La Louptière, Champagne, May 4, 1777, died in Paris, June 21, 1857. He studied

chemistry in Paris under Vauquelin and Fourcroy, in 1798 became a teacher of that science in the polytechnic school, in 1804 professor in the collége de France and the Sorbonne as successor of Vauquelin, and in 1810 also in the polytechnic school. In the latter year he was elected a member of the academy in place of Fourcroy. Charles X. on his accession to the throne made him a baron, and under Louis Philippe he was created a peer in 1832, and in 1838 director of the collége de France. He was president of the society for the encouragement of national industry, and founded a society for the benefit of inventors impoverished by useful researches. His most popular work, *Traité élémentaire de chimie théorique et pratique* (4 vols. 8vo, 1813–'16; 7th ed., 5 vols., 1836), has been translated into several languages.

**THEOBALD, Lewis,** an English author, born at Sittingbourne, Kent, died in September, 1744. He was an attorney, but did not practise. His tragedy "Electra" appeared in 1714; and in 1717 he contributed to Mist's "Weekly Journal" papers under the title of "The Censor," which provoked attacks from other writers, one of whom was Dennis. He published a pamphlet entitled "Shakespeare Restored, or a Specimen of the many Errors as well committed as unamended by Mr. Pope in his Edition of this Poet, designed not only to correct the said Edition, but to restore the true Reading of Shakespeare in all the Editions ever yet published" (4to, London, 1726). For this Pope made him the hero of the "Dunciad." (See Pope, Alexander, vol. xiii., p. 709.) Theobald then brought out an edition of Shakespeare's works (7 vols. 8vo, 1733), which destroyed the reputation of Pope's edition. Theobald wrote or translated 20 plays, now all forgotten, and also brought on the stage a play entitled "The Double Falsehood, or the Distrest Lovers," the greater part of which he asserted was composed by Shakespeare. He also published a life of Sir Walter Raleigh.

**THEOCRITUS,** a Greek poet, born in Syracuse, who flourished about 270 B. C. He went to Alexandria, and secured the favor of Ptolemy Philadelphus, but returned to Syracuse during the reign of Hiero II. He wrote in a mixed dialect in which the Doric predominated, and was the creator of pastoral poetry as a department of literature. There are extant 30 poems, called by the general name of "Idyls," which are attributed to him, and 22 epigrams. He had several imitators, of whom the greatest was Virgil. The first edition, containing only 18 idyls, appeared at Milan probably in 1493, and the Aldine edition in 1495. Among the more important subsequent editions are those of Reiske (2 vols., Leipsic, 1765–'6), Warton (Oxford, 1770), and Paley (Cambridge, 1863). The principal English translations of the poems are those of Creech (London, 1681), Fawkes (1767), Polwhele (1786), Chapman (1836), and Calverly (1869).

**THEODOLITE,** a surveying instrument for measuring vertical and horizontal angles and taking levels, combining the uses of the ordinary transit, the quadrant, and the level. In the American form of the instrument, the telescope turns over and the vertical angles are read on a graduated circle. In the English form the vertical angles are read on a semicircle beneath the telescope and level; the telescope cannot therefore turn over, but is reversible. The American form is preferable by reason of the greater facility and precision of the adjustments. In common with all such kinds of instruments, it is made of brass. The principal parts are the vertical circle A and the horizontal circle F, which rests upon the plate H. A magnetic needle also rests upon the horizontal plate, which may be used when desired for ascertaining the earth's meridian or the deviation of a line from it. The telescope,




Theodolite.

B, revolves on a horizontal axis, also the axis of the vertical circle, and which rests upon the supports S S. Beneath the telescope and attached to it by adjusting screws is the long spirit level L, with a scale attached for marking the position of the air bubble. The small spirit levels D and E serve to level the horizontal circle. The vertical axis of the instrument

is held by a socket in the plate immediately above the tripod, and is furnished with a clamp C, and slow-motion screws T T. The horizontal circle revolves upon the plate H, upon which there is a vernier the divisions of which are sometimes read by means of an attached microscope, although it is preferable to employ a pocket microscope for the purpose. The vertical circle is also supplied with a vernier, and both circles have clamps and slow-motion screws. It is evident that if the vernier of the vertical circle in the adjusted instrument reads zero when the telescope is level, and then is moved through an arc of 30° to bring the cross hairs upon an object, such object will have an elevation of 30° above the point of observation; and also that if the horizontal circle is moved through an arc of any number of degrees to bring the cross hairs of the telescope from one object to another, the lines passing through such objects will make corresponding angles with each other at the point of observation. When used for important surveys the circles are 30 in. or more in diameter; in the smaller instruments they are 5 or 6 in.—See Gillespie's "Treatise on Levelling, Topography, and Higher Surveying" (new ed., New York, 1875).

**THEODORA.** See Justinian.

**THEODORE,** king of Abyssinia. See Abyssinia, vol. i., p. 46.

**THEODORET** (Theodoretus), a Syrian theologian, born at Antioch probably in 393, died in 457 or 458. He was of a noble family, entered a cloister, became in 423 bishop of Cyrrhus on the Euphrates, and reunited many members of the sects with the orthodox church. He declared against the Nestorians, and at the council of Chalcedon, in 451, subscribed the condemnatory decree against Nestorius. He is esteemed as an exegetical writer (see Richter, *De Theodoreto Epistolarum Paulinarum Interprete*, Leipsic, 1822), and he also wrote homilies, a history of the Christian church from 324 to 429, an epitome of heretical fables, the lives of 30 hermits, and various other works, including 180 letters. Collective editions of his works have been edited by Sirmond (4 vols., Paris, 1642; supplement by Garnier, 1684), and by J. L. Schulze and Nösselt (10 parts, Halle, 1769-'74), and in Migne's *Patrologie grecque*, vols. xli., xlii., and xliii. A translation of his "Ecclesiastical History" was published in Bohn's "Ecclesiastical Library" (1854).

**THEODORIC** (Ger. *Dietrich*), surnamed the Great, king of the Ostrogoths, born in Pannonia about 455, died in 526. He was the son of Theodemir, one of the chiefs of the Ostrogoths settled on the banks of the Danube, and when eight years old was sent as a hostage to the court of Constantinople. At the age of 18 he was restored to his father, and, after greatly distinguishing himself in war, he succeeded him as sole king of the Ostrogoths in 475. The southern part of Pannonia and Dacia had previously been ceded to them by the emperor Zeno the Isaurian, of whom Theodoric was for some years a faithful ally; but the emperor broke his promises, and Theodoric ravaged the Byzantine territories till 483, when Zeno conferred upon him large gifts and many honors, and in 484 he named him consul. The war was renewed in 487, and Theodoric marched upon Constantinople; and to get rid of him Zeno proposed to him the invasion of Italy, then ruled by the usurper Odoacer. Consequently in 488 he marched toward the peninsula at the head of his whole people, amounting to about 200,000, with a large number of wagons. He first met in the Alpine passes and routed an army of Gepidæ and Sarmatians, then defeated Odoacer himself on the banks of the Sontius (Isonzo) in 489. After two other victories, one on the banks of the Adige and the other on those of the Adda, he shut his opponent within the walls of Ravenna, and after a siege of three years received his capitulation in 493, apparently consenting to share the kingdom of Italy with him; but Theodoric soon after had his rival assassinated at a solemn banquet, and firmly established his power over the whole peninsula. He distributed one third of the lands to his soldiers in military tenures, but preserved as far as possible the administrative organization of the Roman empire. Under his fostering care Italy became prosperous again; agriculture and industry revived; literature and the fine arts flourished; internal improvements went on, and new monuments were erected. Through well devised alliances, he controlled nearly all the barbarians that had settled in western Europe. He checked the triumphant progress of Clovis after the victory of Vouillé in 507, protected the Visigoths, and secured for himself the possession of Provence. His latter years were embittered by religious troubles. The Arians, to which sect he belonged, being persecuted in the East, he retaliated against the Catholics of Italy; this brought on a conspiracy, in which the philosopher Boëthius, a great favorite with him, and the venerable Symmachus were apparently involved, and in a moment of passion he ordered them to be put to death. Their innocence being afterward demonstrated, remorse preyed upon his mind and hastened his death. He is the Dietrich of Bern of the *Nibelungenlied*.

**THEODOSIA,** or **Feodosia.** See Kaffa.

**THEODOSIUS,** a Roman general, beheaded in Carthage, A. D. 376. During the reign of Valentinian he was sent to the defence of Britain, in 367 crossed the channel at the head of a large army, and in two campaigns freed the country from the barbarians, strengthened the fortifications, and confirmed the Roman power. In 370 he returned, was made master general of the cavalry, and was stationed on the upper Danube, where he defeated the Alemanni. When in 372 Firmus, a Moor, had made himself master of Mauritania and Numidia, and Count Romanus, the governor of Africa, unable to oppose, had joined him in rebellion, Theodosius was sent to that province to reduce

it to its allegiance. At the head of a small body of men, he advanced into the heart of an unknown and hostile country, driving his enemy before him, until at last the usurper fled to Igmazen, king of the Isaflenses. The latter being threatened with destruction for harboring him, Firmus strangled himself. Theodosius recovered Africa, but for some unassigned reason, probably because his name and services were too great for a subject, he was put to death. From him descended a line of Roman emperors.

**THEODOSIUS I., the Great,** a Roman emperor, son of the preceding, born in Italica or Cauca, Spain, about A. D. 346, died in Milan, Jan. 17, 395. He learned the art of war under his father, was early given a separate command and appointed duke of Mœsia, and in 374 gained a victory over the Sarmatians. After the execution of his father he retired to Spain, where he led a private life until the emperor Gratian summoned him to take the supreme command, declared him Augustus, Jan. 19, 379, and assigned to him the administration of Thrace, Asia, and Egypt, with Dacia and Macedonia. Fixing his headquarters at Thessalonica, Theodosius carried on the war against the Goths during four campaigns (379–382). The Goths, divided by dissensions and jealousies after the death of their leader Fritigern, were again united under Athanaric, who made peace and visited Constantinople, where he died; and the magnificent funeral honors paid him by Theodosius so won over his followers that they enlisted in the Roman army. In 383 Gratian, the emperor of the West, was dethroned and put to death by Maximus, and Theodosius entered into a treaty with the usurper, by which he recognized him as emperor of the countries north of the Alps, Valentinian, the brother of Gratian, being secured the possession of Italy, Africa, and western Illyricum. Theodosius now devoted his attention to the affairs of the church. Fixing his residence at Constantinople, the stronghold of Arianism, he determined to do away with that creed, and gave to the archbishop Demophilus the alternative of subscribing to the Nicene creed or instantly resigning. Demophilus resigned, and Gregory Nazianzen was installed in his place. Six weeks afterward Theodosius commissioned his lieutenant Sapor to expel all the Arian clergy from the churches in his dominions, and gave him a military force sufficient to carry out the decree. In May, 381, he assembled the first council of Constantinople, to confirm and complete the Nicene creed; and during 15 years he issued at least 15 edicts against all heretics, especially against those disbelieving the doctrine of the Trinity. In the mean time Maximus had entered Italy, and dethroned Valentinian II. Theodosius, who had married a sister of Valentinian, marched against Maximus, then encamped at the Pannonian city of Siscia (now Sissek) on the Save, defeated him, and pursued him to Aquileia, where Maximus was given up by his own troops and put to death. Theodosius entered Rome in triumph, June 13, 389. The people of Thessalonica having for a slight cause murdered Botheric and the other principal officers of the little garrison, the emperor sent thither an army of barbarians, who, when the inhabitants were assembled by invitation at the circus, massacred them to the number of many thousands. For this St. Ambrose forbade him to enter a church in Milan until he had done public penance. He remained in Italy three years. When Valentinian was strangled in 392 by his general Arbogastes, who had secured for himself all the real power of the government, and now set up as emperor the rhetorician Eugenius, Theodosius undertook again the conquest of the West. After a severe and long uncertain contest he defeated Arbogastes near the passes of the Julian Alps. Theodosius was now master of the whole Roman world. Honorius, his younger son, was called to Milan to receive the sceptre of the West, and here Theodosius died immediately after his arrival. In the eastern empire he was succeeded by his elder son Arcadius.

**THEOGNIS,** a Greek elegiac poet, who flourished about 540 B. C. He was a citizen of Megara; and as in the contests between the aristocratic and democratic parties he belonged to the former, he shared in their defeat, and went into exile at Thebes. He visited Sicily, Eubœa, and Sparta, and survived the Persian war of 490. He is the author of numerous elegies, originally comprising 2,800 verses, of which 1,389 are extant. They discuss oligarchical education and the humanities. The best editions are Welcker's (Frankfort, 1826) and Bergk's in *Poetæ Lyrici Græci* (3d ed., Leipsic, 1866).

**THEOLOGY** (Gr. θεός, God, and λόγος, discourse), the science which treats of God and divine things. The name *theologos* was given by the Greeks to the authors of theogonies (as Orpheus and Hesiod), and to those who wrote poems (as Empedocles) or philosophical treatises (as Pherecydes) on divine things and the origin of things through the gods. A distinction was early made, as by Varro, between "mythical theology," a knowledge of the myths and legends concerning the deities in the classic poets; "physical theology," the investigations of philosophers on the origin of the world; and "civil theology," a knowledge of public worship. The ecclesiastical writers of the 3d and 4th centuries used the word, but applied it only to doctrinal treatises on the nature of the Godhead, or on the Trinity. Somewhat later the term was used by Theodoret, Maximus, and others, of the aggregate doctrines of the Bible, but its most common signification remained the doctrine of God. Abélard was the first to apply the term to the entire science of the Christian religion, which signification it has since retained. With regard to the sources from which theology derives its contents, it is common to divide it into natural or philosophical theology, which confines itself

to the development of the religious ideas resting on rational arguments only, and positive or revealed theology, which sets forth and systematizes the doctrines of the Scriptures and of the church. Revealed theology or Biblical theology is occupied solely with the investigation and representation of the doctrines contained in the Bible. A distinction is made between theoretical theology or dogmatics and practical theology or ethics. Theology, viewed as the whole of religious science, is commonly regarded as consisting of four main branches, historical, exegetical, systematic, and practical or moral theology. These are again variously subdivided, and several auxiliary sciences are connected with them. Thus historical theology embraces the history of the church, of Christian doctrines, of heresies, of councils, &c. To exegetical theology belong the interpretation (exegesis) of the Bible; hermeneutics, the science which teaches the right principles to be observed in interpreting the Bible; criticism, which investigates and tries to establish the genuine original text; the introduction to the Bible, which discusses the time when and place where each book of the Bible originated, its authenticity, and kindred questions. Systematic theology, also called merely theology, comprises the system of Christian doctrines (dogmatics); the system of Christian ethics; symbolics, the comparative statement of the doctrines of the several religious denominations, &c. Practical theology includes homiletics, catechetics, liturgics, ecclesiastical law, &c. Polemics and apologetics, which are also often treated as separate branches of theology, belong to several of the above four principal divisions at the same time.—Until the time of Abélard little attention was paid to comprehending theology in its totality, and to establishing the connection of the branches with each other. Although nearly all the theologians of the middle ages whose writings are extant belonged to the same church, yet they were divided into two fundamentally different schools, the scholastics and mystics. The theologians of the churches which grew out of the reformation of the 16th century followed, in their treatment of theology, either the scholastics or mystics, though the name of the former was discarded both by their Protestant and Roman Catholic followers. A new era in the history of theology was inaugurated by the philosophy of Kant, who fully developed and systematized a new theory of Christian theology, commonly called rationalism, which more or less made the belief in a religious doctrine dependent on its demonstrability by reason. This view gained the ascendancy in several Protestant churches. Its opponents, who defended the Bible as the absolute rule of faith, were called supranaturalists, and the subsequent history of theology is a contest not yet ended between these two systems. The chief arena of this controversy has been Germany; but it has had little or no influence over Roman Catholic schools. It has also been attempted to build up theological systems in opposition to Christianity, such as deism and pantheism.—In Roman Catholic schools, theology is divided into dogmatic and moral. Dogmatic theology, considered in its various methods of exposition and demonstration, is termed positive theology when it bases its proofs on Scripture and tradition. Moral theology treats of divine and human law as the rule of our actions. It aims at determining the true sense of the decalogue and the gospel precepts, discusses virtues and vices, examines the principles of justice and the foundations of injustice, points out what is needful and unlawful, and teaches all Christians their respective obligations in all states, conditions, and offices. Moral theologians are often called casuists, from their treating *ex professo* of "cases of conscience." Scholastic theology is that peculiar method introduced into the schools during the 11th and 12th centuries. It reduced all doctrinal matters into one body, so coördinating them that one question explained and completed another, binding them into a connected and systematic whole; it observed in its every demonstration the strict process of syllogistic reasoning, making use of the admitted principles of metaphysics, and thus conciliating faith with reason, and religion with philosophy.—Valuable systematic works, giving a survey of the entire field of Christian theology, have been published by President Dwight, Dr. J. Pye Smith, Prof. Hodge ("Systematic Theology," 3 vols. 8vo, New York, 1872–'3), and others, and useful encyclopædic manuals by Hagenbach, Pelt, and Staudenmaier.

**THEOPHRASTUS**, a Greek philosopher, born at Eresus, in the island of Lesbos, about 372 B. C., died about 287. His original name was Tyrtamus, and he was surnamed Theophrastus probably for his eloquence. He studied at Athens under Plato and Aristotle, and succeeded the latter at the lyceum. The number of his pupils from all parts of Greece was at one time 2,000. His influence on public affairs excited a party spirit against him, and being brought before the Areopagus on a charge of impiety, he pleaded his own cause, and was acquitted. After this he taught in tranquillity till 305, when Sophocles, son of Amphiclides, carried a law which prohibited all philosophers, under pain of death, from giving any public instruction without the permission of the state. Theophrastus left Athens; but in the next year the law was abolished, and he returned. He wrote works on politics, laws, legislators, and oratory, which are lost, and "A Dissertation on the Senses and the Imagination," a work on "Metaphysics," "Characters," and two works on botany, "The History of Plants" and "The Causes of Plants," which are extant in whole or in part. The book of "Characters" consists of 30 sketches of the general vices of humanity as developed in individuals. His extant works were first printed with those of Aristotle (Venice, 1495–'8); the best edition

is Wimmer's (Leipsic, 1854, and Paris, 1866). His "Characters" were translated into French and prefixed to his own by La Bruyère (1688), and into English, among others, by Francis Howell (London, 1824).

**THEOPHYLACT** (Θεοφυλάκτος), surnamed SIMOCATTA, a Byzantine historian, born of an Egyptian family in Locris in the latter part of the 6th century, died about 629. From 610 till about the close of his life he held various offices at Constantinople. He wrote a history of the reign of the emperor Maurice (582–602), of which a Latin translation, *Historiæ Mauricii Tiberii Imperatoris Libri VIII.*, was published at Ingolstadt in 1648. Besides 85 letters (*Epistolæ Morales, Rusticæ et Amatoriæ*, 4to, Cracow, 1509), he wrote a work on the nature of animals, especially of man ('Απορίαι Φυσικαί, or *Quæstiones Physicæ*, 4to, Leyden, 1596; Leipsic, 1653.) These two works were published together at Paris in 1835.

**THEOPHYLACT**, a Greek theologian, born in Constantinople probably about the middle of the 11th century, died after 1112. He was instructed by Clement, archbishop of Bulgaria, and became archbishop of Achris or Achrida, a chief city of Bulgaria, between the years 1070 and 1077. He engaged in the controversies of his day, especially those relating to the true character, procedure, and office work of the Holy Ghost, and the question whether or not common bread or only unleavened should be used in the sacrament, opposing the views of the Latin church. He compiled commentaries upon the minor prophets and a large part of the New Testament from the works of Chrysostom, and wrote a treatise on royal education (Παιδεία Βασιλική, or *Institutio Regia*) for the instruction of his pupil Prince Constantine Porphyrogenitus, the son of Michael VII. There exist 75 of his letters, with some homilies and orations and a few small treatises. An edition of all his works in Greek and Latin was issued at Venice (4 vols. fol., 1754–'63).

**THERA** (now *Santorin*), an island of the Ægean sea, now forming with Amorgos and other islands an eparchy of Greece, in the nomarchy of the Cyclades; length about 9 m. from N. to S., average breadth about 4 m.; pop. about 13,000; of the eparchy, in 1870, 21,907. It was originally circular, but the islet Therasia was torn from it by an earthquake about 237 B. C., and it now resembles a horseshoe. The harbor thus formed is the crater of a volcano, and as no bottom is found, vessels make fast to the abrupt and rocky shores. The soil is volcanic and inclined to dryness, but very fertile. The annual production of wine is about 1,750,000 gallons. Ship building is the only considerable industry. Thera, the capital, had a population in 1870 of 5,143.—Though an ancient Lacedæmonian colony, Thera is only of historic importance as having sent a colony to found the city of Cyrene in Africa, 631 B. C. The dates of the eruptions known to have taken place in or near this island are 197 B. C. and A. D. 46, 726, 1573, 1707, and 1866. By that of 197 B. C. the island of Palæa (Old) Cammeni was formed, by that of 46 Mikra (Little) Cammeni, and by that of A. D. 1707 Nea (New) Cammeni. The last was at first composed of white pumice, but subsequently received additions of brown trachytic rock. The eruption did not wholly cease or the island assume its present form till 1712. In the beginning of 1866 stones flew up from the port of Volcano, and a new volcano arose which attained a height of about 100 ft. The eruptions continued until the autumn of 1870, and enormous quantities of lava were thrown out, surpassing in size those projected in 1707–'12. Near Nea Cammeni a regular cone was formed 325 ft. high.

**THERAMENES**, a political leader at Athens toward the end of the 5th century B. C., born in Cos. In 411 he became a member of the council of 400; but he deserted it and became one of the leading agents in its overthrow. In 410 he joined the fleet under Thrasybulus, and took part in the battle of Cyzicus; and in 408 he participated in the siege of Chalcedon and the capture of Byzantium, under Alcibiades. He was one of the inferior generals at the battle of Arginusæ in 406; and it was chiefly through his influence that six of the commanders were condemned to death for not saving the drowning crews, although, as they asserted, he had himself been sent with others to perform that office. During the siege of Athens by the Spartan general Lysander, when the city was reduced to great extremity, Theramenes was sent as envoy to the Lacedæmonians. He remained three months with Lysander, who he pretended detained him that length of time without informing him that the ephors only had power to grant peace; and upon his return to the city, which was now suffering under a terrible famine, he was sent back to make peace on any terms. The hard conditions imposed by the Lacedæmonians were assented to (see GREECE, vol. viii., p. 195), and in 404 Theramenes, who during his three months' stay with Lysander had made arrangements with the Athenian oligarchical exiles, was among the most active in subverting the constitution, and became one of the thirty tyrants. He warmly supported the first measures of the government in crushing the democracy and putting to death its prominent leaders; but he afterward opposed the violent measures of Critias and his colleagues. His party daily increased; but Critias, after charging him with being a public enemy, caused him to be dragged off to prison by partisans with concealed daggers whom he had brought into the senate house, and compelled him to drink the hemlock.

**THERESA**, or **Teresa, Saint**, a Spanish mystical writer, born in Ávila, March 28, 1515, died at Alba, Oct. 4, 1582. She was called Teresa de Ahumada (her mother's family name) till Au-

gust, 1562, when she assumed that of Teresa de Jesus. At the age of 20 she entered the order of Carmelites in a convent of her native town, in which she remained 27 years. She then founded a reformed branch of the Carmelites (Barefooted Carmelites), sometimes called after her Theresians. During her life 29 convents of the reformed order were established, and in the 18th century it counted about 2,000 members in six provinces, in Spain and Spanish America. She was beatified by Pope Paul V., April 24, 1614, and canonized by Gregory XV., March 22, 1622, her feast being fixed on Oct. 15. Theresa described the internal struggles and aspirations of her heart and her frequent mystic visions in ascetic treatises and letters, which are among the most memorable documents of the mystic literature of the Roman Catholic church, while their excellence of language and style has secured for them a place in the classic literature of Spain. Five of them are extant: *Discurso ó relacion de su vida*, written in 1562; *El camino de la perfeccion*, prepared in 1563 as a guide for the nuns of her reformed order; *El libro de las fundaciones*, an account of the convents founded by her; *El castillo interior, ó las moradas*, written in 1577, and the most celebrated of her mystic works, in which she portrays in glowing colors the gradual progress of the soul to the seventh heaven, the celestial castle of Christ, her spouse; and *Santos conceptos de amor de Dios*, the original of which she burned in obedience to her confessor, but which has been preserved from a copy taken by one of the nuns. The original manuscripts of the first four works are preserved in the library of the Escurial. The first complete edition appeared at Salamanca in 1587, and a recent one, edited by Ochoa, at Paris in 1847 (*Tesoro de las obras misticas de Santa Teresa de Jesus*). A collection of letters of St. Theresa, addressed to different persons, was published at Saragossa in 1658. The abbé Migne edited a complete collection of her works in French (4 vols., Paris, 1840–'46), and they have been translated into most other European languages. A French translation from the original manuscripts was published by Père Marcel Bouix (3 vols. 8vo, Le Mans, 1852–'6). Among the many lives of St. Theresa are those of Ribera (Salamanca, 1590; French by Père Bouix, Paris, 1865), the Bollandist Vandermoere (Brussels, 1845), and Maria French (London, 1875).

**THERESIOPEL,** or **Maria-Theresiopel.** See SZABADKA.

**THERMAIC GULF.** See SALONICA.

**THERMO-ELECTRICITY,** electricity developed by heat, and also the science which treats of the phenomena and mode of production. Prof. Seebeck of Berlin, in 1822, was the first to make any well directed observations upon the subject. He found that when two rods or bars of different metals were soldered together or otherwise held in intimate contact at their ends, and the junction heated, an electrical disturbance took place, and that if the ununited ends were connected by a conductor an electric current was established. Several crystals, while their temperature is rising or falling, also become oppositely electrically excited at their opposite ends. The term pyro-electricity is usually applied to the electrical phenomena which arise from changes of heat in crystals. These phenomena were first observed in tourmaline, a double-refracting silicate crystallizing in hexagonal prisms. (See TOURMALINE.) Its electrical manifestations are confined within certain limits of temperature, chiefly between 50° and 300° F., but these limits vary with the length of the crystal. If a crystal of tourmaline is suspended by a thread at its middle, and heated, its ends will be attracted and repelled by electrically excited bodies. Many other crystals exhibit like phenomena, but less in degree, which in many cases can only be detected by a delicate electroscope. That pole of a crystal at which the algebraic sign of the change of temperature is the same as that of the electricity developed, that is to say, which manifests positive electricity when the temperature is rising, is called the analogous pole, and the other, the antilogous pole. Brazilian topaz becomes electrical when heated, the Siberian variety slightly, the Saxon not at all. When the first two are treated negative electricity appears at both ends of the crystal, while the positive is developed on the lateral faces. Pyro-electricity is chiefly developed in hemihedral crystals. The phenomena of thermo-electricity in metals is most strongly marked when two metals are heated at their junction; but if a wire of a single metal be tied in a knot, and be heated on one side of the knot, electrical disturbance will take place. When two metals are employed, the strength of the current appears to be in proportion to the difference of temperature of the two metals on each side of the junction, and its direction and also its strength upon the natures of the metals used. In fig. 1, $m\ n$ represents a plate of copper, soldered on to a plate of bismuth, $o\ p$, the middle of which also supports a magnetic needle, beneath the copper plate. If heat be applied at $o$ while the axis of the instrument is in the magnetic meridian, the north pole of the needle will be deflected to the left hand of an observer looking from $n$ to $m$ (see GALVANISM, vol. vii., p. 592), which indicates that a galvanic current is passing through the copper from $n$ to $m$. If however the junction $n\ o$ is cooled, the current will flow from $m$ to $n$. In the following list, according to Becquerel, the direction of the current will be from any element to any one following, the intensity being greatest between the first and the last: bismuth, platinum, lead, tin, gold,

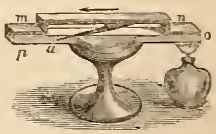


FIG. 1.

silver, copper, zinc, iron, antimony. The direction of the current often changes when the couple is heated beyond a certain degree. Thus, in a copper and iron circuit, the current passes from the copper to the iron through the heated part when the temperature is not higher than 570°; above this the curent passes in the opposite direction. The cause of thermo-electric currents is diversity in the molecular structure of the elements, and Becquerel ascribes them to unequal propagation of heat in the different parts of the circuit. A thermo-electric pile, or battery, in which a series of several couples are joined somewhat like the arrangement in a voltaic pile, or at least with the opposite poles of the elements in contact with each other, was devised by Nobili. A modification of this is shown in fig. 2, in which the lowest plate is bismuth, the next above antimony, the next again bismuth, and so on, the last plate being antimony. These sets of elements are arranged in a copper frame, P, in four vertical series, making in all 20 couples. The terminal plates are connected with binding screws, *m* and *n*, by which they may be connected with a resistance measurer or rheostat, or with a sine or a tangent galvanometer. (See GALVANISM, vol. vii., pp. 593–'5, and DIATHERMANCY, vol. vi., p. 81.) When the pile is composed of a great number of pairs and connected with a very delicate galvanometer, it may be used to detect the slightest changes of temperature; it is much employed in physical investigations, and will undoubtedly in time have extended practical use in physiology and medicine.

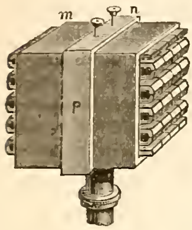


FIG. 2.

**THERMOMETER** (Gr. θέρμη, heat, and μέτρον, a measure), an instrument to measure temperatures. It is formed of two or more different substances, the volumes of which expand and contract to different extents when they are simultaneously exposed to the same differences in intensity of heat. The first attempt at indicating to the eye differences of temperature seems to have been by the contrivance variously ascribed to Drebbel of Holland and Sanctorius of Italy, about the beginning of the 17th century, and known as a weather glass. This was very rude and inaccurate, consisting of a glass bulb and tube inverted, opening below into a cup of colored liquid, which, the air of the bulb having been partly expelled by heat, rose in the tube, and stood at different heights according as the air remaining in the bulb was more or less expanded by heat. This, the origin of the common air thermometer, as improved by Boyle and by the Florentine academicians, became transformed to a smaller bulb with upright stem of somewhat fine bore, the contained liquid being colored spirits of wine; boiling this to expel air, the tube was hermetically sealed, and the whole then affixed to a case. A scale of degrees was also introduced, its fixed points being the cold of snow or ice and the greatest heat known at Florence; it was of necessity very variable in its indications. At this stage in the progress of thermometry, much discussion in regard to the most suitable fixed points for the scale, the best substance for use in the instrument, &c., including that of the question whether water did not freeze at different temperatures in different latitudes, was carried on in England and on the continent. Hooke advocated as the lower fixed point the temperature of freezing water. Newton seems first to have discovered or taken advantage of the facts, that a thermometer placed in melting snow or ice always indicates the same temperature, and always very nearly one temperature in boiling water; but of oil, which he suggested for the liquid in the bulb, the movements were found to be too sluggish and uncertain. Römer, overcoming a prejudice that seems to have existed in regard to unequal expansion of mercury, first adopted that liquid; and he doubtless devised the instrument and scale usually attributed to Fahrenheit of Amsterdam (1720), the latter constructing and introducing the instrument, so that it became generally known throughout Europe in the first half of the 18th century. Of this thermometer, the lower fixed point, or zero, was taken at 32° below freezing point of water; but whether as the cold obtained by its maker by mixing salt and snow, or as the greatest cold observed in Iceland, and in either case as the supposed point of absolute cold, is not now definitely known; and since Fahrenheit kept his graduation of thermometers a secret, the same must be said respecting the choice of a scale of 180° between the fixed points. Celsius of Sweden (1742) introduced a scale of 100° between the fixed points; this was adopted in France at the time of the revolution, and named the *thermomètre centigrade;* and owing to its convenient decimal division, it has been wholly adopted in several countries of Europe, while it is coming into general use among scientific men throughout the world. For the general principles upon which the use of the thermometer depends, see EXPANSION, HEAT, and PYROMETER.—An increase in the temperature of a body is generally accompanied by an increase in its volume, and a decrease in its temperature by a contraction in its volume. Definite changes in the volume of a given substance may be used as indications of this substance having different definite temperatures, and this substance will have the temperature of the bodies by which it is surrounded, or of the medium in which it is immersed, and thus serve to measure their temperature. The substances generally used in the thermometer are glass and mercury, and the observed change of volume is the difference in the change of volume of the glass and of

the mercury. The instrument which shows this difference in expansions is known as the mercurial thermometer. It consists of a tube of very small interior diameter, terminating in a bulb or reservoir. The bulb and a portion of the tube are filled with mercury, and with an increase or a diminution of temperature the mercury will rise or fall in the tube; and the position of the mercury in the tube can be noted on a scale of equal parts either etched on the tube or marked on the surface or a plate to which the tube is attached. Mercury has several advantages as a thermometric substance. The successive increases in its volume for equal and successive additions of temperature, indicated by the air thermometer (see PYROMETER, vol. xiv., p. 111), are quite uniform; especially is this the case when we use the differential expansion of mercury and ordinary glass. The ordinary thermometer when constructed with care is trustworthy in the measure of temperatures up to 300° C. Up to 100° C. mercurial thermometers made of any kind of glass indicate almost exactly the same temperatures as those given by the air thermometer. Another advantage of mercury is that it does not freeze above the low temperature of —40° C., and does not boil below 360° C. But the mercury thermometer only gives accurate indications between —35° and +300° C. For temperatures above 300° C. some form of pyrometer must be used. Mercury has a low specific heat, and this property combined with its high conductivity causes it rapidly to indicate the changes in the temperature of surrounding bodies or of the medium in which it is immersed.—*Construction of the Mercurial Thermometer.* The tube of the thermometer should be of uniform calibre throughout its whole interior. To ascertain whether this is the case, a short column of mercury is introduced into the tube; and if its length remains the same when it is moved throughout the length of the tube, we may be sure that the tube has a uniform bore, and hence that equal amounts of expansion of the mercury will cause equal additions in the length of the mercurial column in the tube. Since tubes of uniform bore are very rare, it is generally necessary to calibrate the tube before its graduation. This is done by etching on the tube a scale of equal parts, and then, from observations on the different lengths occupied by a column of mercury which is made to pass through the tube, forming a table which gives the temperatures corresponding to the arbitrary divisions on the tube. A bulb is now blown on the tube, and this bulb and a portion of the tube are filled with mercury as follows: The air in the bulb is heated while the open end of the tube dips into mercury. The heat having been withdrawn, the air in the bulb contracts and the mercury rises in the tube and partly fills the bulb. To the open end of the tube a funnel containing mercury is adapted, and the mercury in the bulb is boiled and thus expels all air and moisture from the instrument, which on cooling necessarily fills completely with mercury. The bulb is now placed in some fluid heated to a few degrees above the highest temperature which the thermometer is intended to measure, and when the mercury ceases to overflow the open end of the tube is sealed with a blowpipe flame. In order to graduate the instrument, the bulb and part of the tube are surrounded with melting ice, and when the top of the mercury column has remained some time stationary, its position is marked by means of a line, or a note is made of this position, referred to the arbitrary scale etched on the tube. The point on the thermometer determined as above is designated as 0°, or zero degree, on the thermometers known as centigrade (Celsius) and Réaumur, and as 32° on the Fahrenheit system of graduation. To determine a higher point on the thermometer, the instrument is placed in the interior of a metallic vessel with double walls, between which circulates the steam from water boiling in the bottom of the vessel. When the top of the mercury column in the thermometer has become stationary its position is marked on the tube. The boiling point of water is constant at the same atmospheric pressure, and when the barometric column has a height of 29·922 inches or 760 millimetres, the boiling point of water is designated as 100° on the centigrade thermometer, 212° on the Fahrenheit, and 80° on the Réaumur. Hence, between the melting point of ice and the boiling point of water there are 100 equal degrees in the centigrade graduation, 180 in the Fahrenheit, and 80 in the Réaumur. To convert the indications of one of these thermometers into those of the other two, we have the following formula, in which F, C, and R denote equivalent temperatures expressed in degrees of Fahrenheit, centigrade, and Réaumur, respectively:

$$F = \tfrac{9}{5}C + 32 = \tfrac{9}{4}R + 32$$
$$C = \tfrac{5}{4}R = \tfrac{5}{9}(F - 32)$$
$$R = \tfrac{4}{5}C = \tfrac{4}{9}(F - 32)$$

Fig. 1 shows a thermometer graduated according to the three systems. A few weeks after a thermometer has been made and graduated it may be observed that the mercury will not quite descend to the melting point of ice when the instrument is immersed in pounded ice. It has been found that this "elevation of the zero point," as it is called, goes on gradually for about two years after the thermometer has been con-

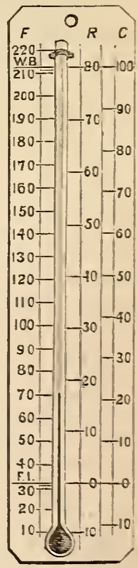


FIG. 1.—Thermometer with Fahrenheit, Réaumur, and Centigrade Scales.

structed, and at the expiration of that period the readings may all be too low by nearly a degree; hence it is necessary either to add the proper correction to the readings of the thermometer, or to slide down and refix the scale to which the thermometer is attached, so that it will read accurately. Alcohol, commonly used where temperatures much below 0° F. are to be observed, is liable at such range to much variation, although it does not freeze even at −132° F.; and Capt. Parry, in his arctic voyages, observed differences of full 10° C. between alcohol thermometers by the best makers.—*Self-recording Thermometers.* Various instruments have been invented which record the indications of the thermometer. They may be divided into two classes, those which record only the maximum and the minimum of the temperatures occurring in any definite period, and those which produce continuous records. In the first class may be mentioned the two following instruments. An ordinary mercurial thermometer has its tube constricted to a thin passage at some point between its bulb and the beginning of its scale. This thermometer is placed in a horizontal position, and then as long as an increase of temperature takes place small portions of

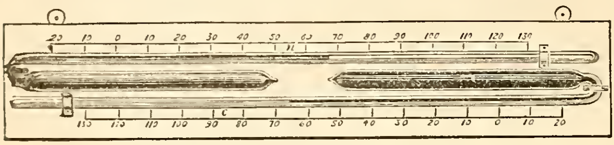


Fig. 2.—Maximum and Minimum Thermometers.

the mercury will go in a series of jumps across the constricted passage; but on a fall of temperature the mercury contracts into the portion of the thermometer below the constriction, leaving a column of mercury above it. The upper end of the latter column marks the highest temperature reached during the time of exposure. To readjust this instrument, the mercury is sent into the vacant space below the constriction by swinging the instrument. Fig. 2 shows this "maximum thermometer," the invention of which has been claimed by several persons. The "minimum thermometer" of Rutherford, which is generally used, is made of alcohol contained in the ordinary glass bulb and tube. In the column of alcohol is a small index made of black glass and shown at $n$, fig. 3. This piece of glass is brought up to the end of the fluid column by inclining the instrument. The thermometer is then placed in a horizontal position, and as the temperature falls the top of the liquid column during its retraction carries the glass index with it, and leaves it at the point which indicates the minimum temperature reached during the exposure of the instrument. The thermometers of

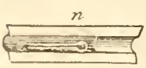



Fig. 3.—Index of Rutherford's Thermometer.

the second class give continuous records, either by causing a tracer attached to some simple or compound metallic bar to mark a continuous line on a cylinder which revolves once in 24 hours, or by the aid of photography a continuous impression of the image of the top of a thermometric column is obtained by illuminating a thermometer placed in front of the lens of a camera, while at the back of the camera is a sensitized plate on which the image is formed. The plate traverses athwart the beam issuing from the lens by a known distance each hour.—*Differential Thermometer.* This is a modification of the air thermometer, in which two large glass bulbs above are connected by a glass tube bent twice at right angles; the horizontal and parts of the upright tubes are filled in the common form with a colored liquid, which is depressed on either side as the corresponding bulb is more heated; thus the instrument indicates differences of the temperatures to which the two bulbs may be exposed. It is very sensitive; and by a scale the results it affords are comparable with each other.

**THERMOPYLÆ**, or simply **Pylæ** (from θερμός, hot, and πύλη, gate), a defile between Thessaly and Locris, in antiquity the only passage for an enemy from northern into central Greece, situated between Mt. Œta and an inaccessible morass forming the edge of the Maliac gulf, and containing several hot springs. There was a road wide enough only for a single wheel track, which formed the western gate. About a mile to the eastward Mt. Œta again approached the sea in a similar manner, and the passage there formed the eastern gate. The space between these two gates was wider, and many years before Leonidas occupied the pass, the Phocians had so conducted the warm springs over the ground as to render the pass impracticable. They had also built a wall near the western gate to prevent the incursions of the Thessalians, which was in ruins when the Spartans came. This pass is celebrated for its defence against the army of Xerxes by the Greeks under the Spartan king Leonidas, in 480 B. C. His forces numbered probably about 7,000; but when during the battle he learned that one Ephialtes, a Thessalian, had betrayed to the Persians a circuitous path over the mountains leading to their rear, he dismissed all but his chosen band of 300 Spartans, with a number of helots, about 700 Thespians who volunteered to share his fate, and apparently 400 Thebans. This small host sallied out and fought till Leonidas and all the Spartans and Thespians were killed. The fate of the Thebans is uncertain; according to some they surrendered to the Persians. One Spartan, Aristodemus, who was prevented by illness from partaking in the combat, returned home, and was received with scorn, but in the following year retrieved his honor by a heroic death at

Platæa. Many other battles took place at Thermopylæ in later times.—The pass is now of little importance as a strategic point. Nature has widened it into a swampy plain from the alluvial deposit of the Sperchens and the retreat of the Maliac gulf. At the S. end of the pass is a mound, supposed to be that to which the Spartans finally retreated and on which they were slain. In a small plain is the Polyandrium, one of the sepulchral monuments of the Greeks who fell at Thermopylæ, and a few miles beyond are the remains of the wall mentioned above, which can be traced from the Maliac gulf to the gulf of Corinth.

**THÉROIGNE DE MÉRICOURT** (more properly MARCOURT), a French revolutionist, whose real name was Anne Josèphe Terwagne, born at Marcourt, Luxemburg, Aug. 13, 1762, died in Paris, June 9, 1817. She was the daughter of a farmer, and was educated at a convent. In 1789 she went to Paris, where she became notorious as the "Amazon of the revolution" and the "handsome Liégeoise." She lived in luxury, gathered around her many conspicuous revolutionists, and appeared with arms in the revolutionary assemblies, in which she spoke with eloquence. In 1790 she was threatened with arrest for participating in violent outbreaks, and fled. Early in 1791 the Austrian authorities arrested her near Liége, and incarcerated her at Kufstein, Tyrol, for alleged conspiracy against Marie Antoinette, and subsequently detained her at Vienna till November. On her return to Paris she became still more popular. In June, 1792, she led a corps of insurgents, and received a civic crown for her courage. Suleau, a journalist, having reviled her, she turned the mob upon him during the outbreak of Aug. 10, 1792, and he was murdered. But when a little later she advocated greater moderation, she was publicly stripped and whipped by infuriated women. This drove her mad, and for the rest of her life she was in a lunatic asylum.—See *Théroigne de Méricourt, dite la belle Liégeoise*, by Fuss (Liége, 1854).

**THESEUS**, a legendary hero of Attica. He was the son of Ægeus, king of Athens, and Æthra, daughter of Pittheus, king of Trœzen. Ægeus on his departure from Trœzen hid his sword and shoes under a stone, and charged Æthra if she gave birth to a son to send him to Athens as soon as he was able to roll away the stone. When Theseus arrived at maturity his mother informed him of his parentage, and taking possession of the tokens he set out for Attica by land, destroying various robbers and monsters on the way. At Athens he was recognized by his father, but narrowly escaped death from the hands of Medea. He engaged in a war with the Pallantids, the sons and grandsons of Pallas, the brother of Ægeus, in regard to the succession to the throne, and was victorious. Next he voluntarily sailed to Crete as one of the tribute youths to be offered to the Minotaur, for the purpose of attempting the destruction of the monster. He gained the affections of Ariadne, daughter of Minos, who furnished him with a sword and a clue of thread, with which he killed the Minotaur and escaped from the labyrinth. Hereupon he carried off Ariadne, whom however he left behind at the island of Naxos. Theseus, if successful, was on his return to hoist white sails instead of the black ones which this vessel always carried; but this arrangement was forgotten, and Ægeus, imagining his son was destroyed, threw himself into the sea. Theseus now ascended the throne. He invaded the territory of the Amazons, defeated them, and carried off their queen Antiope. In revenge the Amazons marched into Attica, and entered Athens itself, but were finally vanquished. He married Phædra, and to her passion his son Hippolytus fell a victim. (See PHÆDRA.) Theseus figures in the principal heroic legends of ancient Greece. He was one of the Argonauts, was engaged in the Calydonian hunt, fought with Pirithous and the Lapithæ against the Centaurs, and also assisted Adrastus in regaining the bodies of those slain before Thebes. Aided by Pirithous, he carried off Helen from Sparta when she was only nine years old. Attica was in consequence invaded by Castor and Pollux. Menestheus incited the Athenians to rise against their ruler; and Theseus, finding it impossible to sustain himself, retired to the island of Scyros, where he was destroyed by the treachery of King Lycomedes. In 476 B. C. the oracle directed his bones to be brought from the island to Athens, and in 469, when Scyros was taken by Cimon, it was pretended the body was found. His bones were laid in the interior of the city, and the temple called the Theseum, built over the spot, served as a sanctuary for poor men in dread of the powerful, and for slaves in case of cruel treatment. At the battle of Marathon Theseus was reported to have been seen armed and aiding the Athenians. Festivals in his honor were celebrated on the eighth day of each month, and the festival termed Oschophoria was said to have been originated by him after his return from Crete. To him was popularly ascribed the reinstitution of the Pythian games.

**THESIGER**, Sir Frederick. See CHELMSFORD.

**THESPIS**, the founder of Greek tragedy, a native of Icaria in Attica, lived in the time of Pisistratus (about 540 B. C.). The ancient traditions represent him as the inventor of tragedy, and to him is also ascribed by some the invention of masks. According to one account, Thespis was in the habit of travelling through Attica at the time of the festival of Bacchus in a wagon, and upon this portable stage performed comic plays. It is also said that he found tragedy already existing in Athens, but made in it the simple and important alteration of introducing an actor for the sake of giving rest to the chorus. Nothing which he wrote is extant, but the titles of four of his tragedies have been preserved.

**THESSALONIANS, Epistles to the**, two canonical books of the New Testament, addressed to the church at Thessalonica by the apostle Paul. They are expressly referred to by Irenæus, Clement of Alexandria, and Tertullian. In modern times the authenticity of both epistles has been doubted by Noack, Van der Vries, and Volkmar, and that of the second by Lipsius, Hilgenfeld, Weisse, Hausrath, Pfleiderer, and others. Special treatises in support of their authenticity have been written by W. Grimm, Lünemann, and others. The first epistle to the Thessalonians, commonly believed to have been the first of the Pauline epistles, is supposed to have been written from Corinth about A. D. 52 or 53. The occasion seems to have been the favorable report of the faith of the Thessalonians which Timothy brought on his return from Macedonia. Chapters i. to iii. express the apostle's feelings respecting their religious condition, and his own kindly reception among them. Then follow an exhortation to holiness (iv. 1–12), an instruction on the fate of the dead at the expected return of Christ (iv. 13–18), an admonition to be always prepared for that event (v. 1–11), several other admonitions, and the conclusion. The second epistle is believed by most of the theologians who regard it as authentic to have been written soon after the first, in the year 53 or 54. It was designed to correct some errors into which the church had fallen, especially respecting the coming of Christ. The apostle commends the Thessalonians for their patience and faith in their persecutions, and announces that those who trouble them will be punished (ch. i.); he shows that the arrival of Christ was not near at hand, but must be preceded by a great apostasy and the appearance of the Antichrist (ii. 1–12), and gives them appropriate admonitions (ii. 13–17, and iii.). Among the most valuable commentaries on these epistles are those by Schott (Leipsic, 1834), Jowett (London, 1856), Lünemann (Göttingen, 1859), Ellicott (2d ed., 1862), Hofmann (1862), and Auberlen and Riggenbach in Lange's *Bibelwerk* (2d ed., 1867; English translation by Lillie).

**THESSALONICA.** See Salonica.

**THESSALY** (Gr. *Θεσσαλία* or *Θετταλία*), the largest political division of ancient Greece, comprising in its fullest extent the country between Thermopylæ and the Cambunian mountains in one direction, and between the range of Pindus and the Ægean sea in the other. But Thessaly proper was the plain between the Cambunian mountains on the north, Ossa and Pelion on the east, Mt. Othrys on the south, and the Pindus range on the west. This plain, whose natural enclosure of mountains is broken only at the northeast by the vale of Tempe, was the most fertile region and the largest that was continuously productive in Greece, and was supposed by its inhabitants to have once been a lake, of which the lakes Nessonis (now Kara Tchaïr) and Bœbeis (Karla) were the remains. It was drained by the Peneus (Selembria or Salamvria) and its tributaries, and was divided into two plains, which in antiquity were called Upper Thessaly and Lower Thessaly; the former embracing Thessaliotis and Hestiæotis, between Æginium in the northwest and Thaumaci in the south, and having Pharsalus for its chief city; the latter, Pelasgiotis, stretching from Mts. Olympus and Ossa on the north to Mt. Othrys and the gulf of Pagasæ (now of Volo) on the south, and having Larissa as its most important town. Thessaly proper was early divided into the four districts of Thessaliotis, Hestiæotis, Pelasgiotis, and Phthiotis; and this division, the origin of which is sometimes ascribed to Aleuas, the founder of the Aleuadæ, was continued down to a very late time. In addition to Thessaly proper, the name was extended over Malis or Malia, a narrow valley between Mts. Othrys and Œta, through which the river Spercheus enters the Maliac gulf; and to Magnesia, a region lying along the coast and stretching S. from the vale of Tempe, and almost encircling the gulf of Pagasæ.—The Thessalians were said to have been originally emigrants from Thesprotia in Epirus, who conquered the Pelasgian inhabitants of the plain of the Peneus, which is said by Herodotus to have then been called Æolis. During the historic period three classes inhabited the country. The first was a body of rich oligarchical proprietors, who owned most of the soil. Of these the most powerful families were the Aleuadæ of Larissa, the Scopadæ of Crannon, and the Creonidæ of Pharsalus; the second were the subject Achæans, Magnetes, and Perrhæbi, who retained their tribe names and separate votes in the Amphictyonic council; the third were the Penestæ or serf cultivators of the soil, who could not be sold out of the country, and who kept up among themselves the relations of family and community. These were no doubt earlier inhabitants reduced to serfdom; but whether they were Pelasgians or Bœotians, as Grote suggests, it is impossible to determine. The language spoken in Thessaly was Æolic Greek. The four divisions of the country formed a political union, existing rather in theory than in fact. To enforce obedience to the common authority a chief or *tagus* was sometimes elected; but constant feuds between the larger cities prevented Thessaly from occupying its rightful position in Greece. The inhabitants were early engaged in a constant war with the Phocians; they joined by constraint the army of Xerxes in his invasion of Greece, but took no part in the Peloponnesian war. About 400 B. C. Pheræ rose to political supremacy in Thessaly under Lycophron, who had made himself tyrant, and his successor Jason, who reduced all Thessaly to his authority, and meditated not only the conquest of Greece, but the overthrow of the Persian empire; but before he had time to mature his designs he was assas-

sinated. Alexander of Pheræ maintained and extended his power (see PHERÆ); but after his death the country fell into the hands of Philip of Macedon. It formed a part of the Macedonian monarchy until the defeat of Philip V. at Cynoscephalæ in 197, when it came under the Roman dominion, and the government was given to wealthy persons, who met in Larissa.—Thessaly now forms a part of the Turkish vilayet of Janina, excepting the southernmost portion, from Mt. Othrys, which belongs to Greece. (See PHTHIOTIS.) The chief town of Turkish Thessaly is Trikala, and of the Greek portion Lamia or Zeitun.

**THETIS**, in Greek mythology, the mistress and chorus leader of the 50 Nereids, the wife of Peleus and mother of Achilles. She dwelt in the depths of the sea with her father Nereus, and was sought in marriage by both Jupiter and Neptune; but the gods relinquished their suit when Themis declared that the son of Thetis should be more illustrious than his father. At her wedding with Peleus all the gods and goddesses were invited, excepting Eris, who revenged herself by throwing the apple of discord among the guests. (See PARIS, and ACHILLES.) She had a temple in Thessaly, and was worshipped in Sparta and Messenia.

**THÉVENOT. I. Melchisedech**, a French traveller, born in Paris about 1620, died at Issy, Oct. 29, 1692. He early explored Europe, learned oriental languages, and in 1684 became keeper of the royal library, of which he published a catalogue in 1694. The gatherings of learned men at his house formed the nucleus of the future academy of sciences. In 1645 he was sent on an official mission to Genoa, and from 1652 to 1655 he was employed by the government in Rome. He published compilations of travels, including *Relations de divers voyages curieux* (2 vols. fol., Paris, 1663–'72), and *Recueil de voyages*, comprising Marquette's *Découvertes dans l'Amérique Septentrionale* (1681). **II. Jean de**, a French traveller, nephew of the preceding, born in Paris, June 6, 1633, died at Miana, Armenia, Nov. 28, 1667. After travelling through Europe, he made two extensive journeys in Asia and Africa, and is said to have first introduced coffee into France. The narratives of his travels were collected under the title *Voyages de M. Thévenot tant en Europe qu'en Asie et en Afrique* (5 vols. 12mo, Paris, 1689), and were translated into English, German, and Dutch.

**THEZA**, or **Tesa**, a fortified town of Morocco, on the Wad el-Asfar (Yellow river), or Sebu, about 60 m. E. of Fez; lat. 34° 9′ N., lon. 3° 55′ W.; pop. about 5,000, of whom 800 are Jews. Its great mosque is a fine building, supported in the interior by antique monolithic columns. Theza is the centre of the trade between Algiers, Tlemcen, and Fez, and caravan roads lead from it to Fighig and Tafilet.

**THIBAUT** (THEOBALD) **IV. or VI.** as count of Champagne, I. as king of Navarre, a French *trouvère* or poet, born at Troyes in 1201, died there or at Pamplona, July 10, 1253. He was a posthumous son of Count Thibaut III. or V., was educated at the court of Philip Augustus under the supervision of his mother, Blanche, daughter of Sancho the Wise, king of Navarre, and became an early adept of the "gay science." Several of his poems were addressed, under an assumed name, to Blanche of Castile, the queen of Louis VIII., whom he loved to distraction, although she was 14 years his senior. When her husband died prematurely at Montpensier in 1226, while returning from an expedition against the Albigenses, Thibaut, who accompanied him, was suspected of being his poisoner. He soon after joined the league of feudal lords who rose against Blanche, then regent; but her influence brought him back to his duty to the king, and through his assistance she baffled the designs of the confederates. In 1234 Sancho died without male issue, and the count of Champagne inherited the kingdom of Navarre in right of his mother. In 1239 he went to the Holy Land; but he met with a dreadful defeat near Gaza, and had to pay a heavy ransom for the release of his brother. His provinces were very prosperous under his government, and he was a patron of literature and the fine arts. He allowed the Albigenses to be persecuted in his dominions, and assisted, May 13, 1239, in the burning at the stake of 83 of them, at Montrimer, near Vertus. Of his poems, 66 songs were published by Lévesque de la Ravallière (2 vols. 12mo, Paris, 1742; best ed. by Rocquefort and Michel, 1829). A collection of 81 songs is contained in Tarbé's *Collection des poëtes champenois* (8vo, Rheims, 1851).

**THIBAUT, Anton Friedrich Justus**, a German jurist, born in Hameln, Hanover, Jan. 4, 1774, died in Heidelberg, March 28, 1840. He graduated at Kiel, taught jurisprudence there from 1799 to 1802, and at Jena till 1805, and was afterward professor at Heidelberg till his death. In 1814 he advocated a national code, but Savigny regarded it as premature. His principal work is *System des Pandektenrechts* (2 vols., Jena, 1803; 9th ed., 1846; abridged English translation, "Introduction to the Study of Jurisprudence," with notes by Nathaniel Lindley, London, 1855). Guyet has edited his posthumous writings (2 vols., Berlin, 1841–'2).

**THIBET**, or **Tibet** (Sansk. *Bhot;* Thib. *Bod;* Pers. *Tibet*), a region of central Asia, between lat. 27° and 38° N., and lon. 78° and 104° E., bounded N. by East Turkistan and China proper, E. and S. E. by China, S. by Burmah, Bootan, Sikkim, Nepaul, and British India, and W. by Cashmere; area estimated at from 650,000 to 800,000 sq. m.; pop. about 6,000,000. Thibet forms the S. E. portion of the great central Asiatic plateau, with a mean elevation of about 15,000 ft. toward its southern edge, which is bordered by the Himalaya. The Kuen-lun range is generally regarded as the northern boundary of the country. The transverse

chains which connect the western extremities of these two great ranges separate Thibet from Cashmere. It appears now to be established beyond doubt that a third lofty and snow-capped chain intervenes between the Himalaya and the Kuen-lun, parallel with them, probably a prolongation eastward of the Karakorum mountains, under the name of Niantsin-tangla according to Ritter, and Tanla according to Huc. Hodgson calls it the Nyenchhen-thangla range. It forms the northern boundary of Great Thibet, a region which extends thence southward about 200 m. to the outer Himalaya overlooking India, and 750 m. from W. to E. along the basin of the Sanpo or upper course of the Brahmapootra. Western Thibet (Thib. *Ari*), in the widest sense, comprises Ladakh (outside of the limits above stated; see Ladakh) and the lofty Himalaya region about the sources of the Ganges and the Sutlej; while of eastern Thibet (Thib. *Kam*) little is known except that it is deeply indented by the gorge-like valleys of the numerous great rivers which flow thence into China, Indo-China, and Burmah.—In its main physical features Thibet is a vast, arid, mountainous plateau, with an altitude seldom less than 10,000 ft. above the sea, except in the lowest valleys, and over a great part of its area more than 14,000 ft. The northern portion of the country, between the Nyenchhen-thangla range and the Kuen-lun, consists of a series of lofty table lands, uncultivated, and inhabited only by nomads and robbers and the residents of the Buddhist monasteries, which are the only permanent dwellings met with in the region. Great Thibet is comparatively a cultivated country, of settled habitations, and contains the capital and principal cities; but by far the largest part of its surface is occupied by vast grassy steppes, which afford abundant and valuable pasture. In western Thibet the area capable of cultivation, or even habitable by man, is proportionately very small, owing to the exceedingly mountainous character of the region.—Thibet has four systems of drainage. North of the great middle range of mountains, on the slopes of which are numerous glaciers, the drainage is wholly interior, the streams being received by the salt lakes which occupy some of the principal depressions. The most considerable of these is that known as Tengri-nor, or more properly Nam-cho, the Sky lake, 15,190 ft. above the ocean, about 50 m. long and from 16 to 35 m. wide. One of the transverse ridges extending northward from the Himalaya separates the southern part of the country into two basins, forming a watershed with the Indus and the Sutlej flowing off its W. slope, while its E. side sends the Brahmapootra to water Great Thibet, which finally likewise makes its way down to the Indian plain. Near the great Kailas peak of the Himalaya are Lakes Rhawan-rhad and Manasarowar, out of which last pours the Sutlej; and the remarkable ring-shaped lake of Palte, or Yamdok-cho, is about 35 m. S. W. of Lassa, in the valley of the Sanpo or Brahmapootra. Lake Koko-nor, in eastern Thibet, is near the head waters of the Hoang-ho.—The nature of the rocks near the southern edge of the table land indicates that the Thibetan plateau must be of recent geological origin. The plains consist of horizontal gravel strata on which rest bowlders, and extensive fossil-bearing deposits occur in the vicinity of the Himalayan range. In the north metamorphic rocks alternate with beds of granite. Among the Nyenchhen-thangla mountains are numerous hot springs, as well as geysers the waters of which freeze as they fall, forming lofty columns of ice.—The climate in the higher districts is cold, dry, and almost rainless, and even the snowfall is light. Timber never rots, but becomes so dry as to break, and the flesh of animals exposed to the air dries till it can readily be reduced to powder. The limit of perpetual snow is higher on the Thibetan than on the Indian side of the Himalaya, which is attributed to the excessive dryness of the atmosphere on the N. slope of the range. It is there 18,000 or 19,000 ft. above the sea, while in India it descends to 15,000 ft. During summer the sky is clear and the atmosphere wonderfully transparent, but the plains are subject to violent winds and dust storms in winter, and the cold is intense. A warmer climate prevails in many of the valleys, where European fruits and vegetables are raised.—With the exception of the pasturage on the steppes, the vegetation of Thibet is scanty. Forest trees are unknown except in some of the mountainous districts, and in such as have been explored they consist principally of cedar and birch. In the warmer valleys the apple, fig, pomegranate, apricot, peach, vine, and several varieties of nuts are grown. Wheat and rice are cultivated sparingly, and some buckwheat, but gray or black barley is the principal grain and the chief article of diet. The mineral productions comprise gold, silver, mercury, cinnabar, lead, iron, salt, and borax, as well as several kinds of precious stones, including lapis lazuli. Gold occurs, not only in the sands of some of the rivers but in many mines, of which perhaps the most productive are in western Thibet N. of the Kailas mountain. There are rich silver mines in the neighborhood of Lassa, and although it is said that the authorities prohibit working them, large quantities of silver are constantly exported from Thibet into China. Salt, which is also an abundant article of export, is obtained by solar evaporation from the saline lakes. The number of animals is greater than might be expected from the scantiness of vegetation; among them are the tiger, ounce, lynx, wolf, fox, bear, buffalo, wild ox, wild goat, long-haired sheep, and yak, which abounds throughout Thibet. The shawl goat is the most important of the domestic animals, and the musk deer the most valuable object of the chase.

Wild fowl and fish are abundant, but Lamaism prohibits them as articles of food.—The Thibetans belong to the Mongolian race, and it is believed that all were once nomadic, as those in the north still remain. They are pliant and agile, usually brave, generous, frank, and honest, eminently commercial in their habits, and many of them skilled workers in gold, silver, and precious stones. They are rude agriculturists. The fine wool which their flocks afford, and the hair of the shawl goat, enable them to manufacture superior woollens and shawls of fine texture. Sacking and other articles are also woven in considerable quantities for the Chinese market. Cloths are dyed with great skill, and the manufacture of pottery and of idols is a thriving trade. The traffic with China is carried on along the great road between Lassa and Tasienloo, a town in the western part of the Chinese province of Sechuen. The exports are drugs, blankets and other woollens, furs, musk, salt, and silver, in return for which China sends cotton goods and thread, ponies from Yunnan, porcelain, and tea. The chief trade routes from India lead through Cashmere and Ladakh, Nepaul, and Bootan, over lofty mountain passes. English woollen cloths, flowered calicoes, indigo, rice, and precious stones, including pearls, turquoises, and dark corals (which here sell for their weight in gold), reach the country by these highways; while gold and silver, salt, borax, wool of the shawl goat, coarse blankets, ponies, and yaks' tails are sent southward into India over the same routes. The roads throughout the country are poor.—The language which is common to Thibet and Bootan, and hence called indifferently Thibetan or Bhotanta, is classed with the monosyllabic languages, though possessing some polysyllables. Its alphabet is phonetic, reads from left to right, and is evidently borrowed from the Sanskrit; but the language owes most of its derivatives and some of its root words to the Chinese. It is copious and well adapted for the expression of philosophical and religious ideas. There is an extensive literature, mainly composed of translations and commentaries on the Buddhist sacred books. The religion of Thibet is Lamaism. (See LAMAISM.) There are some Mohammedans in western Thibet, chiefly natives of Cashmere, and, according to Huc, several thousand Roman Catholics. Polyandry prevails in many districts.—Politically Thibet is tributary to the emperor of China, and is therefore usually classified as a part of the Chinese empire. But the direct government of the country is vested in the two great lamas or priestly rulers, who hold sway respectively in the two provinces into which Great Thibet is divided for spiritual and administrative purposes. These are the province of U, of which Lassa is the capital, ruled over by the dalai lama, and the province of Tsang, to the southwest, over which presides the equally sacred teshu lama, with his capital at the city of Shigatze, about 140 m. further up the Sanpo valley. The combined names of these two provinces form the native appellation Utsang, applied to Great Thibet. As Lassa is the sacred capital of all Buddhistic countries, it is regarded as the capital of Thibet in preference to Shigatze. There are many other large towns, in most of which the Chinese government has its governors or representatives, who exert great influence if not positive authority over the Thibetan rulers. A considerable Chinese military force has usually been maintained in the country.—As a kingdom Thibet is said to date from A. D. 313. Buddhism was first introduced, according to some authorities, as early as the 4th or 5th century; but its general diffusion there is of later date. After various struggles with China, Thibet finally became tributary to that empire about the middle of the 17th century. The country was visited by Jesuit missionaries in the 17th and 18th centuries. Thomas Manning, an English traveller, made his way to Lassa in 1812, and the abbé Huc in 1845–'6. Although western Thibet has been frequently and quite thoroughly explored, Great Thibet and the eastern and northern parts of the country are very imperfectly known. Much valuable geographical information has recently been acquired, however, through the efforts of the trigonometrical survey of British India, by which native Asiatics trained for the purpose have been despatched to explore the regions N. of the Himalaya. In 1865 and 1871 Great Thibet was visited by three of these trans-Himalayan explorers, and many of the results of their observations are incorporated in this article.

**THIERRY. I. Jacques Nicolas Augustin**, a French historian, born in Blois, May 10, 1795, died in Paris, May 22, 1856. He was educated at the college of Blois and the normal school in Paris, where he began his career in 1814 as a disciple and literary collaborator of Saint-Simon, whom he left in 1817 to elaborate his new historical theories according to the principles of nationalities. He wrote much for the *Censeur européen* (1817–'20), and established his reputation as the most original historian of his day by his *Histoire de la conquête de l'Angleterre par les Normands* (3 vols., 1825; 10th ed., 2 vols. 8vo, 1858, and 4 vols. 12mo, 1860), English translations of which were published in 1825 and 1847, the latter by Hazlitt. These labors impaired his sight, which he lost altogether in 1826, but he continued them with the assistance of secretaries, of whom Armand Carrel was one of the first. After the accession of Louis Philippe, he spent several years with his brother Amédée at Vesoul. At Luxeuil, where he resided in summer, he married in 1831 Julie de Querangal, daughter of a rear admiral, who became of great assistance to him as an amanuensis, and who published several works of her own. She died in 1844, and after residing for some time with the princess Belgiojoso, he spent the rest of his life with his brother's family. Guigniaut characterized

him, in an essay read in 1862 before the academy of inscriptions, as a martyr, and as the first historical scholar who had vindicated the rights of oppressed nationalities. His works include *Lettres sur l'histoire de France* (1827; latest revised ed., 1859); *Dix ans d'études historiques* (1834; 9th revised ed., 1857; English translation, "Historical Essays," 1845); *Récits des temps mérovingiens* (1840; 8th ed., 1864; English translation, 1846); *Recueil de monuments de l'histoire du tiers état*, prepared under the direction of the government and with the assistance of several writers (vols. i. to iii., 1850-'56); and *Essai sur l'histoire de la formation et des progrès du tiers état* (1853; English translation by Francis B. Wells, 2 vols. 12mo, London, 1855). He prepared a complete edition of his works (8 vols. 18mo, 1846-'7; new ed., 10 vols., 1856-'60). **II. Amédée Simon Dominique**, a French historian, brother of the preceding, born in Blois, Aug. 2, 1797, died in Paris, March 26, 1873. He was educated at the college of Blois, and in 1820 received an office in the ministry of marine. In 1828 he was for a short time professor of history at Besançon. At Guizot's recommendation he was appointed in 1830 prefect of the department of Haute-Saône. At the end of 1838 he entered the council of state, of which he was also a member during the second empire, and in 1860 was made a senator. He was less brilliant but more judicious than his brother. His works include *Histoire des Gaulois jusqu'à la domination romaine* (3 vols., 1828; 6th ed., 1866); *Histoire de la Gaule sous l'administration romaine* (3 vols., 1840-'47); *Histoire d'Attila et de ses successeurs* (2 vols., 1856; 3d ed., 1864); *Récits et nouveaux récits de l'histoire romaine* (1860-'64); *Tableau de l'empire romain* (1862); *Saint Jérôme: la société chrétienne à Rome et l'émigration romaine en Terre Sainte* (2 vols., 1867); and *Saint Jean Chrysostome et l'impératrice Eudoxie: la société chrétienne en Orient* (1872).—His son, Gilbert Augustin, published in 1875 a historical drama entitled *Aventures d'une âme en peine*.

**THIERS**, a town of Auvergne, France, in the department of Puy-de-Dôme, on the Durolle, 23 m. E. N. E. of Clermont; pop. in 1872, 16,635. It has two interesting churches, and is chiefly noted for extensive manufactories of cutlery. Paper, playing cards, candles, ribbons, and thread are also manufactured.

**THIERS, Louis Adolphe**, a French statesman, born in Marseilles, April 16, 1797, died in Paris, Sept. 3, 1877. He was educated at Marseilles and studied law at Aix, where he practised from 1818 to 1821. He then followed Mignet to Paris, where he wrote for the *Constitutionnel* and other journals. He became a favorite of Laffitte and Talleyrand, and wrote *Histoire de la révolution française* (10 vols., 1823-'7; English translation with notes by F. Shoberl, 5 vols., London, 1838). In January, 1830, he, Mignet, and Carrel started the *National*, which promoted the change of dynasty effected by the revolution of the following July. Under Louis Philippe he became an official in the treasury and a member of the chamber of deputies. The ministry of finance was tendered to him, but he recommended Laffitte as its chief, though he virtually acted in that capacity, and retired with him, March 13, 1831. On joining Soult's cabinet, Oct. 11, 1832, as minister of the interior, he procured with Deutz the arrest (Nov. 6) of the duchess de Berry (see Berry), and immediately left the department. This act he had deemed necessary for the pacification of the Vendée at the time when all the military resources were needed for the relief of Antwerp in the interest of Belgian independence. Resuming office in December as minister of commerce and agriculture, he obtained large appropriations for public works. Early in 1834 he returned to the interior department, and quelled the bloody insurrections at Lyons and Paris. After ministerial combinations which revealed his disagreement with Soult and Molé and his rivalry with Guizot, he finally retained his office under the duke de Broglie, and at the same time (December) took his seat in the French academy. The attempt of Fieschi upon the king's life (July 28, 1835), from which he himself barely escaped, made him support the restrictive press and jury laws, known as the laws of September. He resigned with the other ministers in January, 1836, on the rejection of the bill for the conversion of the *rentes*, but in February became premier and minister of foreign affairs. On Aug. 25 he retired, chiefly on account of the king's opposition to armed intervention in Spain. His successor Molé in vain tempted him in 1838 with the Russian mission, to get rid of his influence. He was reinstated as premier March 1, 1840, and proposed the fortification of Paris and extraordinary armaments to prepare for war, in view of the complications arising from Mehemet Ali's conflict with the sultan; but being again baffled by the king's "peace at any price" policy, he resigned, and was succeeded by Guizot, Oct. 29. He now began his *Histoire du consulat et de l'empire* (20 vols., 1845-'62; English translation by D. F. Campbell, London, 1845-'62), for which he visited England and examined the battle fields in Germany, Italy, and Spain. At the same time, as the recognized leader of the opposition, he advocated enlightened measures of education and progress, and opposed ultramontane schemes and political corruption. He also denounced the right of search, and the excessive complacency toward England in the Pritchard question (see Du Petit-Thouars), and in adopting her objections against the incorporation of Texas with the United States, on which occasion he deprecated alienation from the "great American nation, the harbinger of French liberty." Shortly before the outbreak of the revolution of 1848 he made withering attacks upon Louis Philippe's pusillanimity in foreign affairs, and favored politi-

cal reforms, but not a republic. Yet when this became an accomplished fact (Feb. 24), he accepted it as a protection against monarchical factions, and in June was elected to the constituent assembly. When Cavaignac asked for extraordinary powers against the socialists, he was the first to concede them; but subsequently he supported Louis Napoleon for the presidency, and fought a duel with Bixio for repeating a rumor, which he denied, that he had previously disparaged such an election. Elected to the legislative assembly, he was one of the most active leaders of the reactionary majority. In January, 1851, however, after the removal of Changarnier, he raised his warning voice against a new Napoleonic empire. In November he adjured the assembly to adopt Baze's resolution for its military protection, and in vain admonished the radicals that the rejection of this measure threatened the safety of the most truly representative body which France ever had. He was arrested on the *coup d'état* of Dec. 2, imprisoned till Jan. 9, and banished till Aug. 7, 1852. He kept aloof from politics until the apparent relaxation of the autocratic régime encouraged him in 1863 to solicit the suffrages of Paris liberals, who returned him (May 31), despite governmental opposition. In 1865 he referred in his great speech on the budget to the extravagant expenditures for the Italian war, the Mexican expedition, and Haussmann's stupendous enterprises. In 1866 and 1867 he exposed the fatal blunders of the emperor in permitting the aggrandizement of Prussia and the unification of Italy, to the detriment of the grandeur of France. In 1870 he opposed the declaration of war against Prussia, maintaining that the government, being unprepared, was rushing to a certain defeat; and his influence rose with the verification of his predictions. He urged the vigorous defence of Paris, and visited the principal foreign courts to secure their influence in favor of an armistice. On his return in October, he had several interviews with Bismarck, but without results excepting that his efforts increased his popularity and the universal confidence in his statesmanship. On Feb. 8, 1871, he was elected to the assembly in 26 departments, and selected that of Seine-Inférieure. On Feb. 17 he was chosen by the assembly as chief of the executive. His great measures were the immediate negotiation of the preliminary treaty of peace, his crushing of the commune, and the wonderfully successful national loan for paying the German indemnity and the redemption of the territory. On Aug. 31 his term of office was prolonged by the assembly for three years, with the title of president of the republic. He was always a protectionist, and on the rejection of the tariff bill he resigned (Jan. 20, 1872); but he was finally induced to remain, and his subsequent intention to withdraw was arrested (Nov. 29) by the appointment of a committee for regulating his relations with the assembly. In foreign affairs he favored peace and non-intervention. After he had succeeded in substituting Verdun for Belfort as a pledge in German hands, he concluded in March, 1873, a new convention providing for the whole indemnity and for the final withdrawal of the remaining German troops in September, for which he received the thanks of the legislature as one "who deserved well of his country." But on May 24 he was baffled in his attempt to make the republic permanent by legislative enactment, and therefore resigned, and was succeeded by MacMahon. He afterward strongly upheld the republican form of government, which he advocated with great force at Arcachon, Oct. 17, 1875. On Jan. 30, 1876, he was elected to the new senate for Belfort, and on Feb. 20 to the assembly for Paris; and in March he took his seat in the latter body.—His literary fame rests upon his historical works. His other publications include *Histoire de Law* (1826; new ed., 1858; English translation by F. S. Fiske, New York, 1859); *Le monarchie de* 1830 (1831); *De la propriété* (1848); and *L'Homme et la matière* (1875 *et seq.*). Near the close of his life he visited Italy to gather additional materials for a long projected history of art, and was also engaged upon his memoirs. As a speaker his vivacity, parliamentary experience, and perfect mastery of the questions discussed made him exceedingly effective. His house in the place St. Georges, destroyed under the commune, was restored by the government, and continued to be the centre of the most influential society.

**THIERSCH. I. Friedrich Wilhelm**, a German philologist, born at Kirchscheidungen, near Freiburg, June 17, 1784, died in Munich, Feb. 25, 1860. He studied in Leipsic and Göttingen, and in 1809 became professor at the gymnasium in Munich. Being looked upon as a foreigner by the Bavarians, he wrote a vigorous pamphlet entitled *Ueber die angenommenen Unterschiede zwischen Süd- und Norddeutschland* (1810). Soon after its publication an attempt was made to assassinate him. In 1811 he founded a philological institute, which in the following year was incorporated with the university of Munich, and from 1811 to 1829 he edited the *Acta Philologorum Monacensium*. He took a special interest in the Hellenic struggle for independence and in the amelioration of education in Greece, and published in 1833, after a two years' sojourn in that country, *L'état actuel de la Grèce, et des moyens d'arriver à sa restauration*. In his work *Ueber die neuesten Angriffe auf die Universitäten* (1837) he expressed anew his conviction of the importance of classical studies, and in 1838 initiated a bitter literary warfare against Diesterweg, Linde, Schmitthenner, and others, by his *Ueber den gegenwärtigen Zustand des öffentlichen Unterrichts in den westlichen Staaten von Deutschland, in Holland, Frankreich und Belgien*. He wrote a Greek grammar, with special reference to the Homeric dialect, which passed

through several editions, and has been translated into English and other languages. He published also a school edition of this work, an account of his travels in Italy (1826), an edition of Pindar (2 vols., 1850), and other school books and philological treatises. His life has been written by his son Heinrich (2 vols., Leipsic, 1866). **II. Heinrich Wilhelm Josias,** a German theologian, son of the preceding, born in Munich, Nov. 5, 1817. He was professor at Marburg from 1843 to 1864, and subsequently resided at Heidelberg. He is the principal representative of Edward Irving's doctrines in Germany. His works include *Geschichte der Kirche im apostolischen Zeitalter* (2 vols., Frankfort, 1852; English translation, London, 1854), and *Ueber christliches Familienleben* (6th ed., 1872).

**THIONVILLE.** See DIEDENHOFEN.

**THIRD ESTATE.** See STATES GENERAL.

**THIRLWALL, Connop,** an English historian, born at Stepney, Middlesex, Feb. 11, 1797, died July 27, 1875. He was educated at Cambridge, was tutor, Craven scholar, Bell's scholar, and senior chancellor's medallist, received the degree of master in 1821, and became a fellow. He was called to the bar in 1825, but in 1828 entered the church, and became rector of Kirby-under-Dale, Yorkshire. In 1840 he was created bishop of St. Davids, which office he resigned in June, 1874. With J. C. Hare he translated the first two volumes of Niebuhr's "History of Rome" (1828), and he contributed to Lardner's "Cabinet Cyclopædia" a history of Greece (1835 *et seq.*), afterward enlarged (8 vols., 1845–'52). He published a speech delivered in the house of lords in 1869 on the Irish church, and several sermons. His "Literary and Theological Remains" were edited by Canon Perowne (3 vols., London, 1875–'6).

**THIRST,** the sensation by which the want of fluid in the system is made known, dependent on the condition of the stomach, throat, and fauces, and in a state of health a tolerably faithful indication of the requirements of the body. It is generally considered as immediately resulting from an impression on the nerves of the stomach, as it is allayed by the introduction of liquids through a tube, so that the fauces are not touched; in this way speedy relief is obtained, because of the instantaneous absorption of the fluid by the veins of the stomach. This, however, must be taken with some qualification, as the intensity of thirst bears no necessary relation to the amount of liquid in the stomach, but indicates a want of the system which can be supplied through the blood vessels, the rectum, or the skin; in fact, the conditions are very analogous to those mentioned under HUNGER. A supply of fluid, as indicated by thirst, is necessary to make up for the losses by cutaneous and pulmonary exhalation, and by the urinary and other secretions, which are effected chiefly at the expense of the water in the blood. Thirst is greatest in a dry and hot air, when the perspiration and other secretions are excessive; salted or highly spiced food, strong fermented liquors, and irritating substances and poisons applied to the intestinal mucous membrane, excite thirst, no doubt to induce an ingestion of fluid by which they may be diluted. A sudden loss of blood, either by the lancet or from a wound, or a rapid drain on the vascular system, as in Asiatic cholera, diarrhœa, or diabetes, causes thirst in proportion to its amount. Thirst is less when the food is watery, and when liquid can be absorbed by the skin from the surrounding air or water. The thirst of fever does not necessarily indicate a pressing demand for fluids, but depends on the dryness and heat of the throat, mouth, and skin, with diminished transpiration, and is better relieved by small pieces of ice than by copious draughts of water. Animals with naked skins, like batrachians, living in water or moist air, have no need to drink to quench thirst, cutaneous absorption supplying the necessary fluid. The camel, on the other hand, supports thirst for a long time, carrying a supply of fluid in the water stomach. The daily quantity of fluid taken by a man depends upon the temperature, the amount of exercise and perspiration, and the nature of the food. As a general rule, a man in good health, taking a fair amount of bodily exercise, consumes about 2½ lbs. of solid food and rather less than 3 lbs. of liquid food in a day. But as most articles of solid food, such as meat, bread, and vegetables, themselves contain a notable proportion of water, they contribute so far to satisfy the daily demand for liquids. The body requires to be supplied, either in the solid or liquid form, with about 4½ lbs. of water daily; and if this quantity from any cause be deficient, the sensation of thirst indicates the requirements of the system. Every loss of water from the body, as above mentioned, increases this demand. Consequently, when from any accidental circumstance, as in cases of shipwreck, a sufficient supply of water for drink cannot be obtained, every care should be taken to prevent the loss of fluids from the system. The avoidance of perspiration, the protection of the skin from evaporation, and frequent bathing in salt water when practicable, are all efficient in diminishing the danger, and in protracting as long as possible the period of endurance.

**THIRTY YEARS' WAR,** a religious and political conflict which involved the German empire, and with it the principal states of Europe, from 1618 to 1648. The causes which led to this struggle reach back to the early part of the 16th century, when the reformation divided Germany into two hostile religious parties. Protestantism, nearly crushed in the war of the Smalcald league, rose triumphant under Maurice of Saxony, and with the peace of Augsburg (1555) Charles V. beheld the chief aim of his policy for ever frustrated. By the terms of this peace, which extended to those Protestants only who had embraced the confession of Augsburg, the right was secured to each

state of prescribing the form of worship within its limits, and to all subjects, Lutheran or Catholic, the privilege of emigrating from the states where their creed was prohibited. The Protestants were to retain the ecclesiastical possessions which they had appropriated previous to the peace of Passau in 1552. But though the basis of a definite settlement was established, two important points remained on which no agreement could be reached. The Catholic party, to guard against the danger that would accrue to the church in the future appropriation of her prelacies by the Protestants, introduced an article, known as the ecclesiastical reservation, by which all prelates who should henceforth abjure Catholicism were to forfeit their benefices. This article was inserted against the protest of the Lutheran members of the diet. The other point related to Protestant subjects in the ecclesiastical states, for whom the Protestant members sought to secure the right of worship in such territories. The Catholics refused to admit such an article, and they could only obtain instead a personal declaration to the same effect from the emperor's brother Ferdinand, who presided at the diet of Augsburg. The exclusion of the Calvinists proved another source of contention. Under the rule of Ferdinand I. (1556–'64) and his son, the mild Maximilian II. (1564–'76), a general tranquillity was maintained, while the balance was fast turning toward the side of the Protestants, who in the Austrian territories began to tyrannize over the Catholics. The bigoted Rudolph II. (1576–1612), swayed by the Jesuits and the court of Spain, resolved to repress Protestantism, and in his immediate dominions proceeded to restrict, and finally even to abolish the Protestant worship. Religious disputes again distracted Germany. The enmity between Lutherans and Calvinists equalled their mutual hate for the Catholics. The aulic council, whose decisions were inspired by the imperial court, usurped an unlawful jurisdiction in the empire. In Aix-la-Chapelle the Protestants established their worship in spite of the Catholics (1580), and at first beat back the troops sent to execute the imperial ban. About the same time an opportunity was presented of enforcing the ecclesiastical reservation. Gebhard, archbishop of Cologne, abjured his faith to marry a Calvinist lady, but determined not to renounce his see. He was accordingly placed under the ban of the empire, and a war ensued, which ended in his defeat and expulsion in 1584. A violent contest followed for the see of Strasburg. In 1607 the Protestant imperial city of Donauwörth, whose inhabitants an abbot had provoked to acts of violence by processions, prohibited within the town, was deprived of its liberties, in open violation of the peace of religion. Alarmed for their safety, the Protestant princes, in May, 1608, formed at Auhausen in Franconia an offensive and defensive league styled the "Evangelical Union." It soon comprised the Palatinate, Neuburg, Baden, Würtemberg, Brandenburg, Strasburg, Nuremberg, and other states of the empire. Frederick IV., elector palatine, a Calvinist, was placed at its head, though its most active member was Christian of Anhalt. The Lutheran elector of Saxony, however, declined to join the union. On their side the Catholic states, independently of Austria, established the league (July, 1609), with Maximilian, duke of Bavaria, at their head. In the mean while the Protestants of Hungary and Austria had risen against Rudolph and recovered their rights (see RUDOLPH II., and MATTHIAS); and thus encouraged, their brethren in Bohemia, in July, 1609, wrung the *Majestätsbrief* from the emperor. Amid these disorders the heirless duke of Jülich died (March, 1609), leaving a host of claimants to his dominions, which were at once jointly seized by Brandenburg and Neuburg. Rudolph ordered a levy of troops to enforce their sequestration. The Protestant princes flew to arms, and invoked the aid of France, the Netherlands, and other powers. Henry IV. of France now hoped to execute his design of humbling the house of Hapsburg, and was preparing to invade Germany when the dagger of Ravaillac terminated his career (May 14, 1610). Hostilities ceased, but under the emperor Matthias, who succeeded in 1612, the unsettled claims of Jülich again led to war, and Dutch and Spaniards, called in by Brandenburg and Neuburg respectively, occupied the disputed lands. Matthias, being without heirs, was induced to put forward as his successor his cousin Ferdinand of the Styrian line, whose bigotry and rigor alarmed the Protestants. Ferdinand was nevertheless crowned in Bohemia in 1617 and in Hungary in 1618. But already in Bohemia an event had occurred which precipitated the thirty years' war. The Protestant inhabitants of Klostergraben and Braunau had erected new churches against the prohibition of the archbishop of Prague and the abbot of Braunau, lords of the two places, who enforced their authority by seizing the buildings. Protestants and Catholics appealed to a somewhat obscurely worded clause in the *Majestätsbrief*, which the former contended gave the right of building new churches to the Protestants of the towns in general, while the latter maintained that it extended only to the states and royal towns. The court supported the Catholics, and refused all redress. The storm now burst. On May 23, 1618, an assemblage of Protestants, led by Count Thurn, entered the palace at Prague, and seizing Slavata and Martinitz, the most odious members of the council of regency appointed by the crown, hurled them together with their secretary from a lofty window. They escaped as if by a miracle. Thurn and his associates organized a general rising, and evoked the assistance of the union and of Bethlen Gábor of Transylvania. In a short time nearly all Bohemia was in their hands. They were joined by the Sile-

sians, and by Mansfeld with 4,000 men raised by the union. Matthias was forsaken by the empire, and the troops of Spain sent to his aid, under Bucquoy and Dampierre, were unable to check the insurrection, which spread into Upper Austria and Moravia. In the midst of this crisis Matthias died (March, 1619), and Ferdinand, abandoned by his subjects, was soon shut up in Vienna by the victorious Thurn. His firmness and timely succor from Dampierre saved his sinking throne. Thurn withdrew, and Ferdinand, hastening to Frankfort, was elected emperor (August, 1619). The Bohemians, who had declared their throne vacant, offered it to the young elector palatine Frederick V., son-in-law of James I. of England, and he was crowned in Prague. Bethlen Gábor overran Hungary, and Vienna was again threatened, but again saved. The emperor now prepared to conquer Frederick by means of the duke of Bavaria, who was to be indemnified for his services. Maximilian assembled the forces of the league, awed the union into inaction, and quickly subdued Upper Austria. John George, the elector of Saxony, though a Protestant, took up arms against Frederick, and overran Lusatia, and the Spanish general Spinola invaded the Lower Palatinate, while Maximilian joined Bucquoy in Bohemia. The battle of the White mountain, before the walls of Prague, Nov. 8, 1620, drove Frederick from his throne, and left Bohemia to the vengeance of the emperor. Executions and confiscations followed. The Protestant worship was abolished, the kingdom given over to the Jesuits, and the *Majestätsbrief* cut into pieces. The electoral dignity, forfeited by Frederick, and the Upper Palatinate, were eventually transferred to Maximilian. The battle of Prague was followed by the dissolution of the Protestant union, but the intrepid Mansfeld, who had not shared in the defeat, determined to retain his army. He marched from Bohemia to Alsace, and struggled with Tilly, the general of Maximilian and the league. George Frederick, margrave of Baden-Durlach, and Christian of Brunswick, a lawless adventurer like Mansfeld, who made war support war, took up arms for Frederick. Tilly crushed the margrave at Wimpfen on the Neckar, and routed Christian at Höchst (1622). Christian and Mansfeld passed into the Netherlands, but soon renewed the contest with Tilly, who finally drove them from the field. Bethlen Gábor, who had broken the peace of Nikolsburg and penetrated into Moravia, made a truce with the emperor in 1624. The Catholic party was triumphant, but the persecutions and the excesses which now ensued rekindled the flames of war. The states of Lower Saxony rose in 1625, and united with Christian IV. of Denmark, who took the lead in the struggle. England sent subsidies, Holland aided with troops, and Christian of Brunswick and Mansfeld reappeared in the field. Hitherto it was not with the forces of Austria but with those of the league and Spain that Ferdinand had carried on the contest. Wallenstein now came forward with his remarkable offer, and with his own resources raised a vast and independent army for the emperor. In April, 1626, he nearly annihilated the army of Mansfeld at Dessau, and pursued him into Hungary, while Tilly in August overwhelmed the king of Denmark at Lutter. Wallenstein returning drove back the Danes into Jutland and their islands, occupied Mecklenburg and Pomerania, and extended his designs to the Baltic, when the walls of Stralsund arrested his career (1628). Peace was made with Christian IV. at Lübeck, May, 1629. The Protestants were everywhere subdued. Ferdinand had proceeded to consummate the work of the Catholic reaction. He issued the edict of restitution, dated March 6 (N. S.), 1629, ordering the surrender by the Protestants of all mediatized church property secularized since 1552, and the transfer to Catholic prelates of all immediate sees held by Protestants against the ecclesiastical reservation, including two archbishoprics and many important bishoprics. This impolitic measure inflamed afresh the Protestant states. Magdeburg firmly resisted its execution. But the power of Austria and the league was suddenly repressed by a new attack from the north. Ferdinand was combating France in the contest for Mantua. Richelieu, eager to involve him in a foreign war, mediated a truce between Gustavus Adolphus and Poland, and the Swedish hero came forward to the rescue of German Protestantism. At the very moment of this new danger, the league, exasperated by the conduct of Wallenstein, compelled Ferdinand to dismiss him, and Tilly received the chief command. In June, 1630, Gustavus landed in Pomerania and entered into a treaty with the aged and overawed duke Bogislas XIV., and in January, 1631, concluded a subsidiary alliance with France. John George of Saxony, George William, elector of Brandenburg, and other Protestant princes met at Leipsic in February, 1631, and formed a league of neutrality. William V. of Hesse-Cassel became the bold ally of Sweden. Gustavus forced the imperialists from Pomerania and advanced through Brandenburg, but was unable to prevent the terrible fate of Magdeburg, which on May 10 (N. S., 20) was stormed by Tilly and Pappenheim. He now compelled the elector of Brandenburg to enter into a treaty, avoided an engagement with Tilly, and restored Mecklenburg to its dispossessed dukes. Tilly, who had received orders to break up the Leipsic union, attacked Saxony, and drove the mean-spirited elector into an alliance with Sweden. Gustavus marched against him, and on Sept. 7 (N. S., 17), 1631, Tilly sustained a crushing defeat at Breitenfeld near Leipsic. The Catholic power lay prostrate. While the Saxon general Arnheim invaded Bohemia and occupied Prague, Gustavus carried his victorious arms to the Rhine and into Swabia, forced the passage of the Lech,

where Tilly was mortally wounded (April 5, 1632), and overrunning Bavaria threatened the Austrian dominions. He was checked by Wallenstein, who, after witnessing with secret joy the misfortunes of the Catholics, had been reinvested by Ferdinand with the supreme command. A new army had arisen at his call. He was joined by Maximilian and Aldringer with the forces of the league, and at Nuremberg the contending armies stood face to face till their ranks wasted away. Then carrying the war northward, they fought a desperate battle at Lützen, Nov. 6 (N. S., 16), 1632. Gustavus fell, but the Swedes remained masters of the field. Pappenheim was among the slain. The death of the Swedish king, which was followed by that of the unfortunate Frederick V., spread consternation among the Protestants. But the Swedish chancellor Oxenstiern was equal to the occasion, while generals like Bernhard of Weimar, Horn, Baner, and Torstenson, trained in the school of Gustavus, emulated his deeds. In 1633 Oxenstiern assembled the states of upper Germany at Heilbronn, and was charged with the conduct of the war. Wallenstein, instead of securing to the emperor the advantages resulting from the death of his great adversary, surprised the world by his inactivity and mysterious conduct. He led his army into Silesia, and confronted the Saxons and Swedes, but wasted the campaign in negotiations. With a devoted army at his command, he was now bent exclusively on schemes of personal ambition. The suspicions of the court were aroused, and his treasonable designs ended in his assassination in February, 1634. (See Wallenstein.) The chief command was transferred to the emperor's son Ferdinand, who, seconded by Gallas and Piccolomini, advanced through Bavaria. He was joined by Charles of Lorraine and a Spanish army, and on Sept. 6 the Protestant forces under Bernhard of Weimar and the Swedish general Horn were nearly annihilated at Nördlingen. This blow was followed by the defection of the elector of Saxony, who in May, 1635, entered into the peace of Prague with the emperor and turned his arms against his recent allies. The acceptance of the terms of this peace, which sacrificed the Calvinists and Swedes, was to be made compulsory in all the states and enforced by an army of execution. Many of the Protestant states assented or were forced to yield, but Sweden, having no alternative short of relinquishing her conquest, determined to continue the struggle. Richelieu seized the opportunity offered by the depression of the Protestant cause to promote the aggrandizement of France. He renewed the alliance with Sweden, declared war against Spain, and made Bernhard commander of his German allies. Baner began a series of brilliant campaigns, won a great victory over the armies of John George and Hatzfeld at Wittstock, Sept. 24, 1636, and carried the war into the Austrian territories. In the mean while France was attacked by the Spaniards, the imperialists, and Charles of Lorraine, and John de Weert spread terror to the gates of Paris. In February, 1637, the emperor died, and was succeeded by his son Ferdinand III. The year 1638 opened with the successes of Bernhard, who in February captured John de Weert and other generals at Rheinfelden. In December he took the important fortress of Breisach, and outwitted the French by appropriating his conquests. On his sudden death in 1639, France obtained control of his army, and pressed the war with vigor. Torstenson, a general unsurpassed in the celerity of his movements, who became the Swedish commander-in-chief on the death of Baner in 1641, shook the Austrian throne by repeated invasions, overthrew the archduke Leopold William and Piccolomini at Breitenfeld, Oct. 23, 1642, chastised Christian IV. for his designs against Sweden, completely defeated Gallas in 1644, won a great victory at Jankau in Bohemia, Feb. 24, 1645, taking Hatzfeld prisoner, and marched on Vienna. Rákóczy, prince of Transylvania, advanced through Hungary, and Vienna barely escaped the combined attack. On the side of the French, Guébriant signalized himself at Kempen in January, 1642, and the young duke d'Enghien (the future Condé) beat the Spaniards at Rocroy in 1643. But in November, 1643, the French suffered a great defeat at Tuttlingen in Swabia through the genius of John de Weert. Condé and Turenne retrieved this disgrace near Nördlingen in August, 1645, where Mercy, their eminent adversary, fell. Turenne and Wrangel, the successor of Torstenson, reduced Maximilian of Bavaria, the steadfast ally of Austria, to the last extremity. Königsmark, another Swedish general, made himself master of a part of Prague in July, 1648, and the old town, on the opposite bank of the Moldau, had been attacked, though fruitlessly, when on Nov. 3 the news came of the signing of the peace of Westphalia. This peace terminated a struggle which had converted Germany into a vast field of desolation and horror. —As early as 1641 the preliminaries regarding the conduct of the negotiations had been arranged at Hamburg, and Münster and Osnabrück in the circle of Westphalia assigned for the meeting of two separate congresses. At Münster the empire, France, Spain, and the Catholics generally were to negotiate, under the mediation of the pope; and at Osnabrück the empire, Sweden, and the Protestants, under that of Denmark. But discussions on ceremonial and the varying fortunes of the war caused years to elapse before the congresses could assemble and enter upon earnest deliberations. Denmark and the pope ultimately withdrew, and Venice became the mediator. Separate treaties were concluded at Osnabrück (Aug. 6, 1648) and Münster (Sept. 8), and on Oct. 24, 1648, the definitive signatures were annexed. Nearly every power of

Europe was represented. Holland and Switzerland were declared independent of the empire. France gained Alsace, and was confirmed in the possession of the bishoprics of Toul, Metz, and Verdun. Sweden received Pomerania W. of the Oder, together with Stettin and other towns, the island of Rügen, Wismar, and the secularized sees of Bremen and Verden; the whole to be held as a fief of the empire, with three votes in the diet. The Swedes were furthermore accorded 5,000,000 thalers. Brandenburg retained further Pomerania, received the secularized sees of Halberstadt, Minden, and Cammin, and secured the succession to the see of Magdeburg. The elector of Saxony was to retain Lusatia and some minor acquisitions; and the secularized bishoprics of Schwerin and Ratzeburg were allotted to Mecklenburg. The Upper Palatinate with the dignity of elector was confirmed to Maximilian of Bavaria, and an eighth electorate was erected for Charles Louis, son of Frederick V., who recovered the Lower Palatinate. By a singular article the see of Osnabrück was to be alternately vested in a Catholic bishop and a prince of the house of Brunswick-Lüneburg. The possession of the ecclesiastical benefices was placed on the basis of Jan. 1 (N. S.), 1624; and in the case of the Palatinate, Baden-Durlach, and Würtemberg, the Catholics were obliged to accept 1618 as the normal year. The treaty introduced an age of more general toleration in Germany. The peace of religion of 1555 was confirmed and extended to the Calvinists, and the equality of the Catholic, Lutheran, and Reformed creeds was established. In all religious questions the Protestants were to have an equal weight with the Catholics in the diet and high courts of the empire. Each state of the empire was to exercise the right of sovereignty, with the liberty of concluding treaties and alliances. The autonomy thus accorded to the states, and the still further diminution of the emperor's authority, weakened the structure of the Germanic body, and paved the way for foreign intervention. The constitutional provisions of the treaty became the fundamental law of the empire. The peace of Westphalia terminated the religious wars of Europe, and forms a grand landmark in its history. The empire had declined into little more than a confederation of states, and the era of French greatness succeeded to that of Hapsburg ascendancy. Spain acknowledged the independence of Holland, and continued the war against France with disastrous results.—See the histories of the thirty years' war by Schiller, K. A. Menzel (3 vols., Breslau, 1835–'9), Gindely (Prague, 1869), and S. R. Gardiner (London, 1874); also Sir Edward Cust, "Lives of the Warriors of the Thirty Years' War" (London, 1865); Ranke, *Geschichte Wallensteins* (Leipsic, 1869); and Felix Stieve, *Ursprung des dreissigjährigen Krieges*, 1607–1619 (vol. i., Munich, 1875).

**THISBE.** See Pyramus and Thisbe.

**THISTLE,** the common name for plants of the genus *cnicus* (Gr. κνίζειν, to prick), of the composite family. In most works the American species are placed under *cirsium*, a genus mainly differing from *cnicus* by the character of the pappus, and some European authors unite all the thistles under *carduus*. Gray in a late revision of the North American thistles ("Proceedings of the American Academy") restores them to the Linnæan genus *cnicus*. The name is sometimes used in combination for plants not closely related; thus the teasel is called fuller's thistle. The thistles are herbs, often with perennial roots, with sessile alternate leaves which are often much divided and prickly; the branches of the stem terminated by heads of flowers (often very large), with an ovoid or spherical involucre, the scales to which are imbricated in many rows, and tipped with a point or prickle; the flowers in the head are all tubular and similar, usually perfect, but sometimes diœcious; their usual color is purple, but in some species they are yellowish or cream-colored; the receptacle on which the flowers are placed is furnished with numerous soft bristles; the one-seeded akenes bear at the top a pappus, or tuft of numerous hairs, which are united into a ring at the base and are feathery with smaller hairs, forming the well known thistle down. About 30 species are found in the United States; two of them are introduced, and are among the most common and most annoying weeds. The common thistle (*C. lanceolatus*), often called in this

Common Thistle (Cnicus lanceolatus).

country bull thistle, is one of these, and the most frequent of all the species. The large leaves are decurrent, *i. e.*, their bases are prolonged downward upon the stem as a spiny, lobed wing; they are prickly on the upper surface and covered below with cobwebby hairs; the heads, about an inch in diameter, have all the scales tipped with prickles, the

outer ones spreading; flowers purple. This is a large showy species; its stems in rich soil are 3 to 4 ft. high, and its robust spreading leaves give it a formidable appearance, while in reality it is very easily destroyed; its root being biennial, there is no danger that it will retain possession of the soil. In Great Britain this is called spear thistle; it is the Scotch na-

Canada Thistle (Cnicus arvensis).

tional emblem. The other introduced species is *C. arvensis*, known as the creeping thistle in Europe, and in this country by the misnomer of the Canada thistle; it is a perennial, spreading rapidly and extensively by its long creeping rootstocks, which send to the surface numerous stems 18 in. to 3 ft. high; the handsomely cut leaves are smooth, or somewhat woolly below, and very prickly on the margins with slender spines; the heads about half an inch in diameter, on short pedicels and forming a loose terminal corymb; the outer scales of the involucre with minute prickly points; flowers pale lilac. In this species the flowers are diœcious, the male heads nearly globular, with more conspicuous flowers than the female heads, which are longer; plants of each sex form separate patches. This plant, which has followed cultivation to nearly all parts of the world, is supposed to have received the name by which it is exclusively known in this country from its having been introduced in the fleeces of sheep brought from Canada; it is justly regarded by our farmers, as it was in Lapland in the days of Linnæus, as "the greatest pest of our fields;" its deep roots, below the reach of the plough, and its abundant seeds, furnish it with ample means for spreading; the creeping rootstock is exceedingly tenacious of life, and when broken every fragment is capable of forming a new plant. Many states have a law which makes it obligatory on each owner to destroy it upon his land, under penalty of its being done by the authorities and the cost charged as a tax. Like other perennial weeds, it soon yields to frequent mowing; but to be effective this must be persistent. None of our native thistles can be regarded as troublesome weeds. The yellow thistle (*C. horridulus*) is found near the coast; the pasture thistle (*C. pumilus*) is a low species with very large heads of fragrant purple (or white) flowers; the tall thistle (*C. altissimus*), a more southern species, is often 10 ft. high and a rather showy plant. The blessed thistle (*C. benedictus*), so called on account of its former use in medicine, is barely naturalized southward.—The cotton thistle, of a closely related European genus, is *onopordon acanthium*; it is a stately plant covered with whitish cottony hairs, and is occasionally met with in the older states. This is said to be cultivated in Scotland as the Scotch thistle, but the best authorities give the common species already described as the emblematic thistle. The milk thistle is *silybum Marianum*, related to the true thistles, and sometimes cultivated in old gardens; it has purple flowers, and leaves blotched with white. Torch thistle is a name given in tropical countries to the tall species of *cereus* of the *cactaceæ*. Sow thistles are coarse composite weeds of the genus *sonchus*.

**THISTLE, Order of the** (also called the order of St. Andrew), a Scottish order of knighthood, reputed on very insufficient grounds to be of great antiquity. The thistle is mentioned as the national emblem of Scotland in the inventory of the effects of James III., who is thought to have adopted it. It appears on coins of James IV., James V., Mary, and James VI., on the last with the motto *Nemo me impune lacessit.* A collar of thistles appears on the gold bonnet pieces of James V. of 1539, and with the royal ensigns depicted in Sir David Lindsay's armorial register of 1542. But this was a mere device. The order had no distinct existence previous to 1687, when a warrant for its restitution was issued by James VII. of Scotland and II. of England. It fell into abeyance after the abdication of James, but was restored by Anne in 1703, and is now one of the recognized orders of the British empire. The warrant of 1687 confined the number of knights to 12, besides the sovereign; but since May, 1827, it has been permanently extended to 16.

**THOLUCK, Friedrich August Gottreu**, a German theologian, born in Breslau, March 30, 1799. He completed his education at the university of Berlin, and was thoroughly converted from his skeptical tendencies under the influence of Schleiermacher and Neander, and more especially through Baron von Kottwitz, a member of the Moravian brotherhood. In 1824 he became professor of oriental literature at Berlin, and in 1826 was transferred to Halle, where he has labored ever since, except in 1828–'9, when he was chaplain to the Prussian embassy at Rome. He at first suffered persecution from the prevailing rationalism of his colleagues, but succeeded in effecting a radical

change, the whole theological faculty of Halle becoming decidedly evangelical. His numerous works include *Wahre Weihe des Zweiflers* (1824; 8th ed. published in 1867 under the title *Die Lehre vom Sünder und vom Versöhner;* translated into English by Ryland, with an introduction by John Pye Smith, "Guido and Julius, the Doctrine of Sin and the Propitiator," republished in Boston, 1856); *Blütensammlung aus der morgenländischen Mystik* (1825), a collection of translations from the mystic poets of the East; commentaries on the Epistle to the Romans (1824, twice translated into English), the first exegetical fruit of the new evangelical theology; the Gospel of John (1827; translated into English by Kaufmann, 1836, and by Dr. C. P. Krauth, Philadelphia, 1859), less thorough but better adapted for students than his other commentaries; the sermon on the mount (1833; translated into English by R. L. Brown, Edinburgh, 1860), his most elaborate and valuable exegetical production; the Epistle to the Hebrews (1836); and the Psalms (1843; translated into English, Philadelphia, 1859); *Die Glaubwürdigkeit der evangelischen Geschichte* (1837), a vindication of the Gospels against the mythical theory of Strauss; *Stunden der Andacht* (2 vols., 1840; 7th ed., 1867), containing several original hymns; *Vorgeschichte des Rationalismus* (4 vols., Halle, 1853–'62); *Predigten über die Hauptstücke des christlichen Glaubens und Lebens* (5 vols., 3d ed., Gotha, 1863–'4); and *Geschichte des Rationalismus* (part i., Berlin, 1865). His complete works are in 11 vols. (1863–'72).

**THOMAS. I.** A S. W. county of Georgia, bordering on Florida, and drained by the Ocklockonee river and its head streams; area, 920 sq. m.; pop. in 1870, 14,523, of whom 8,363 were colored. The surface is level and the soil fertile. The Atlantic and Gulf railroad traverses it. The chief productions in 1870 were 248,618 bushels of Indian corn, 58,962 of oats, 58,187 of sweet potatoes, 6,092 bales of cotton, 24,022 lbs. of wool, and 21,378 of rice. There were 907 horses, 1,026 mules and asses, 3,375 milch cows, 7,631 other cattle, 9,805 sheep, and 14,916 swine. Capital, Thomasville. **II.** An unorganized N. W. county of Kansas; area, 1,080 sq. m. It is intersected in the northwest by the N. and S. forks of Sappa creek, and contains the sources of Saline river, the N. and S. forks of Solomon river, and Prairie Dog creek. It has a rolling surface and productive soil, well adapted to stock raising.

**THOMAS, Charles Louis Ambroise,** a French composer, born in Metz, Aug. 5, 1811. In 1828 he was admitted to the conservatory of Paris, where in 1829 he took the first prize for piano playing, and in 1830 for harmony; two years later the academy of fine arts gave him the first prize for musical composition, which entitled him to a course of musical instruction in Italy, where he remained several years. Returning to Paris in 1836, he composed the following operas, which were represented: *La double échelle* (1837); *Le perruquier de la régence* (1838); *La Gypsy*, a ballet (1839); *Le panier fleuri* (1839); *Carline* (1840); *Le comte de Carmagnola* (1841); *Le guerrillero* (1842); *Angélique et Médor* (1843); *Le caïd*, a comic opera (1849); and *Le songe d'une nuit d'été.* His later works are *Raymond*, *La Tonelli*, *La cour de Célimène*, *Psyché*, *Le carnaval de Venise*, *Mignon* (1866), and *Hamlet* (1868). The last two are the best of this composer's efforts, though *Hamlet* is redeemed from dulness only by the fine music of the fourth act. The opera was written for Mlle. Nilsson, who created the rôle of Ophelia. He is now (1876) engaged upon a grand opera, *Francesca da Rimini.*

**THOMAS, Christians of St.** See Christians of St. Thomas.

**THOMAS, George Henry,** an American soldier, born in Southampton co., Va., July 31, 1816, died in San Francisco, March 28, 1870. He graduated at West Point in 1836, was assigned to the artillery, and served in the Florida war (1840–'42). In the war with Mexico (1846–'8) he was engaged in the defence of Fort Brown, and took part in the battles of Monterey and Buena Vista, being successively brevetted as captain and major. He served in the war against the Seminole Indians in 1849–'50, from 1851 to 1854 was instructor of artillery and cavalry at West Point, and was afterward on frontier duty, principally in California and Texas, till 1860, and was wounded in a skirmish with the Indians near the head waters of the Brazos. On the outbreak of the civil war he was made colonel of cavalry, and took part in the operations in the valley of the Shenandoah in the summer of 1861. In August he was made brigadier general of volunteers, and, being in command of a division of the army of the Ohio, took part in the operations in Tennessee and Mississippi. He was made major general of volunteers, April 25, 1862, and was engaged in the operations in Alabama, Tennessee, and Kentucky. During Rosecrans's campaign in Tennessee and Georgia he commanded a corps of the army of the Cumberland, and bore an important part in the battle of Murfreesboro, Dec. 26, 1862, to Jan. 2, 1863, and in that of Chickamauga, Sept. 19, 20, 1863, where his firmness prevented that check from becoming a disaster. In October he was placed in command of the department and army of the Cumberland, and was made brigadier general of the regular army. At the battle of Chattanooga three divisions of his army gave the finishing blow at Missionary ridge. During Sherman's Atlanta campaign the army of the Cumberland, comprising three corps and three cavalry divisions, was constantly engaged. In October, 1864, Thomas was sent to Nashville, to concentrate the forces in Tennessee against the invasion of Gen. Hood, whom he finally routed before Nashville, Dec. 15, 16. He was made major general, and received the thanks of congress for his conduct in these operations, March 3, 1865; and on the first anniversary of

the battle of Nashville a gold medal was presented to him by the state of Tennessee. From June, 1865, to March, 1867, he was in command of the military division (afterward the department) of the Tennessee, his headquarters being at Nashville and Louisville. He was subsequently assigned to the command of the third military district, comprising Georgia, Florida, and Alabama, and next to that of the Cumberland; and in 1868, having declined the brevet rank of lieutenant general, on the ground that he had since the war done nothing to entitle him to such promotion, he was placed in command of the fourth military division, comprising the territory on the Pacific coast, including Alaska, respecting which he made a valuable report.

**THOMAS, Isaiah,** an American printer, born in Boston in 1749, died in Worcester, April 4, 1831. He commenced business as a printer in Newburyport in 1767. In 1770 he removed to Boston and established the "Massachusetts Spy," in which he attacked with great boldness the oppressive measures of the British government toward the colonies; and Gov. Hutchinson vainly endeavored to procure his indictment. In 1775 he took an active part in the skirmish at Lexington, and on May 3 commenced issuing his paper from Worcester. In 1788 he opened a bookstore in Boston, and soon after established branches of his business in various parts of the United States, while continuing to reside in Worcester. In 1791 he printed an edition of the Bible in folio, and subsequently issued numerous editions of smaller size. For many years most of the school books of the country were printed and published by him. In 1810 he published his "History of Printing in America" (2 vols. 8vo). The American antiquarian society of Worcester was founded through his efforts in 1812, and liberally endowed by him.

**THOMAS, Joseph,** an American author, born in Cayuga co., N. Y., about 1811. He was educated at the Rensselaer institute, Troy, and at Yale college, was for some time professor of Latin and Greek in Haverford college, Pa., took the degree of M. D. in Philadelphia, and settled there as a physician. In 1857–'8 he was in India studying oriental languages. He is the author of the system of pronouncing geographical names in "Baldwin's Pronouncing Gazetteer" (Philadelphia, 1845), of the geographical and biographical vocabularies in several editions of Webster's Dictionary, and of "Travels in Egypt and Palestine" (1853). With Thomas Baldwin he edited "A New and Complete Gazetteer of the United States" (1854), and "Lippincott's Pronouncing Gazetteer of the World" (1855; new ed., 1866); and he edited alone a "Comprehensive Medical Dictionary" (1864), and a "Universal Pronouncing Dictionary of Biography and Mythology" (2 vols. large 8vo, 1870–'71).

**THOMAS, Saint,** also called Didymus, one of the twelve apostles. Both names, the Hebrew Thomas (Th'om) and the Greek Didymus, denote a twin. Thomas is rarely mentioned in the New Testament, and little is known of him. The principal traits of his character are given in the Gospel of John. When Jesus after his crucifixion appeared to his disciples, Thomas was not present, and refused to believe until he himself saw and touched Jesus. As to the scene of his apostolical labors, the statements of the ecclesiastical writers of the first centuries do not agree; according to some it was Parthia, according to others Egypt and Ethiopia, and according to others India, where the Portuguese in the 16th century asserted that they had found his body. An ancient sect (see CHRISTIANS OF ST. THOMAS), who early in the middle ages were numerous in Persia and still survive in India, claim St. Thomas as their founder; but many theologians consider the account of the labors of St. Thomas in India as having been invented by the Manichæans, and as early as the 5th century the Thomas of India was regarded by Theodoret as a disciple of Manes. To the apostle Thomas an *Evangelium Infantiæ Christi* (also called *Evangelium secundum Thomam*) is ascribed, which pretends to fill up the gaps left by the canonical Gospels in the time from the infancy of Jesus until his public appearance; but it has always been regarded as apocryphal. (See Thilo, *Acta Thomæ Apostoli*, Leipsic, 1823.) St. Thomas is commemorated in the Roman Catholic church on Dec. 21; in the Greek church on the first Sunday of her church year, beginning with Easter (hence called Thomas Sunday).

**THOMAS À KEMPIS.** See KEMPIS.

**THOMAS AQUINAS.** See AQUINAS.

**THOMASIUS. I. Christian,** a German philosopher, born in Leipsic in January, 1655, died in Halle, Sept. 23, 1728. He was educated by his father, the rector of the celebrated *Thomasschule*, and from 1675 to 1679 studied at Frankfort-on-the-Oder. Returning to Leipsic in 1679, he undertook a course of lectures at the university, and in 1687 he began to lecture in the German instead of the Latin language. From 1688 to 1690 he issued a monthly series of papers devoted chiefly to current literature. Persecution finally forced him to flee from Leipsic, and he went to Berlin, where he was kindly received by the elector Frederick III., afterward King Frederick I. of Prussia. He subsequently delivered lectures at Halle, and his success induced the elector in 1694 to found the university of Halle, of which in 1710 Thomasius became rector and dean of the faculty of jurisprudence. It was principally by his exertions that trials for witchcraft and torture were abolished in Germany. His most important works are: *Historie der Weisheit und Thorheit* (Halle, 1693), and *Vernünftige und christliche, aber nicht scheinheilige Gedanken und Erinnerungen über allerhand auserlesene, gemischte philosophische und juristische Händel* (3 vols., 1723–'6). His life

has been written by Luden (*Christian Thomasius nach seinen Schicksalen und Schriften*, Berlin, 1805), and by Wagner (1872). **II. Gottfried**, a German theologian, a descendant of the preceding, born in 1802, died in 1875. He was a Lutheran pastor and teacher in Nuremberg from 1829 to 1842, and for the rest of his life professor of dogmatics at Erlangen. He was one of the founders of the *Zeitschrift für Protestantismus und Kirche*. His works include, besides treatises on the Lutheran church, *Origines: ein Beitrag zur Dogmengeschichte des 3. Jahrhunderts* (1837); *Beiträge zur kirchlichen Christologie* (1845); and *Christi Person und Werk* (3 vols., 1856–'64).

**THOMASSIN, Louis de**, a French theologian, born in Aix, Provence, Aug. 28, 1619, died in Paris, Dec. 24, 1695. He studied in the college of Marseilles, became a member of the French Oratory, was appointed to the chair of philosophy in the college of Pézenas, where he adopted Platonic principles, and taught dogmatic theology for six years at Saumur. From 1654 to 1667 he was professor of dogma in the seminary of St. Magloire, Paris, also delivering lectures on church history and discipline. He seemed at first to favor the opinions of the Jansenists, but soon declared against them. In 1667 he published *Dissertationes in Concilia Generalia et Particularia*, in which he taught that to the pope alone belongs the right of assembling general councils; that these councils are not in themselves necessary; that in all matters of discipline and government the authority of the pope is superior to that of a general council; that the question of papal infallibility should never be discussed, but that it was "sufficient to hold that the pope is greater than himself when at the head of a council, and a council inferior to itself when separated from the pope." These opinions aroused the hostility of the parliament and of the Gallican portion of the clergy, and the regent suppressed the work. His most important works are: *Mémoires sur la grâce* (3 vols. 8vo, 1668; 2 vols. 4to, 1682); *Ancienne et nouvelle discipline de l'Église touchant les bénéfices et les bénéficiers* (3 vols. fol., 1678–'9; translated into Latin by the author, 1688, 1728); *Dogmata Theologica* (3 vols. fol., 1680–'89; 6 vols., 1864–'9); *Traité de l'unité de l'Église et des moyens que les princes chrétiens ont employés pour y faire rentrer ceux qui en étaient séparés* (1686–'8); and *Traité des édits et autres moyens spirituels et temporels dont on s'est servi dans tous les temps pour établir et pour maintenir l'unité de l'Église catholique* (3 vols. 4to, 1703).

**THOMASTON**, a town of Knox co., Maine, adjoining Rockland, on the Knox and Lincoln railroad, 60 m. E. N. E. of Portland; pop. in 1870, 3,092. The state prison is situated here, and extensive granite quarries in the neighborhood are worked by convict labor, which is also employed in the manufacture of boots, shoes, and carriages. The inhabitants are chiefly engaged in manufacturing and exporting lime and in ship building. About 140,000 casks of lime are produced annually. There are a few other manufactories, two national banks, a savings bank, a fire insurance company, and six churches. Thomaston was incorporated in 1777, and included until 1848 Rockland and South Thomaston.

**THOMPSON**, a S. E. central county of Dakota, recently formed and not included in the census of 1870; area, about 925 sq. m. It is intersected by the Dakota or James river and its N. fork. The surface is rolling prairie.

**THOMPSON, Augustus Charles**, an American clergyman, born in Goshen, Conn., April 30, 1812. He was educated at Yale college, at the theological seminary at East Windsor Hill, Conn., and at the university of Berlin. Since 1842 he has been pastor of the Eliot Congregational church, Roxbury, Mass. In 1854–'5 he accompanied the Rev. Dr. Anderson as a deputation to the missions of the American board in India. He has published "Songs in the Night" (Boston, 1845); "The Lambs Fed," which has been translated into the Mahratta language; "The Young Martyrs;" "Last Hours, or Words and Acts of the Dying" (1851); "The Poor Widow, a Memorial of Mrs. Anna F. Waters" (1854; translated into Tamil); "The Better Land" (1855); "The Yoke in Youth, a Memorial of H. M. Hill" (1856); "Gathered Lilies, or Little Children in Heaven" (1858); "Feeding the Lambs" (1859); "Morning Hours in Patmos" (1860); "Lyra Cœlestis" (1863); "The Mercy Seat" (1863); "Seeds and Sheaves" (1868); and "Christus Consolator" (1869).

**THOMPSON, A. Wordsworth.** See p. 908.

**THOMPSON, Benjamin.** See RUMFORD.

**THOMPSON, Cephas G., Jerome, and Cephas.** See p. 909.

**THOMPSON, Daniel Pierce**, an American novelist, born in Charlestown, Mass., Oct. 1, 1795, died in Montpelier, Vt., June 6, 1868. He was admitted to the bar in Virginia, practised law in Montpelier, Vt., and held the offices of register of probate, clerk of the legislature, compiler of the statutes, judge of probate, clerk of the county and of the supreme court, and secretary of state. He published "May Martin, or the Money Diggers" (1835, many times reprinted); "Adventures of Timothy Peacock" (1835); "The Green Mountain Boys" (Montpelier, 1840); "Locke Amsden," a graphic picture of the New England district school as it was (Boston, 1847); "Lucy Hosmer" (1848); "The Rangers, or the Tory's Daughter" (1850); "Gant Gurley, or the Trappers of Lake Umbagog" (1857); "The Doomed Chief" (1860); and "History of the Town of Montpelier, Vermont" (1860). From 1849 to 1856 he edited the "Green Mountain Freeman" newspaper.

**THOMPSON, Elizabeth**, an English painter, born in London about 1850. In 1874 she acquired great fame by her "Roll Call," relating to the Crimean war, which was purchased by the

queen. In the summer of 1875 she exhibited another military picture, and at the close of the same year, on her return from Italy, a "Vintage Sketch in Tuscany."

**THOMPSON**, Sir **Henry**, an English surgeon, born at Framlingham, Suffolk, Aug. 6, 1820. He was educated at University college, London, became assistant surgeon of the college hospital in 1853, surgeon in 1863, and professor of clinical surgery in 1866, and was knighted in 1867. He has published "The Pathology and Treatment of Stricture of the Urethra" (London, 1853; 3d ed., 1869); "The Enlarged Prostate, its Pathology and Treatment" (1857; 2d ed., including the Jacksonian prize essay of the royal college of surgeons for 1860, 1861; 3d ed., 1868); "Practical Lithotomy and Lithotrity" (1863; 2d ed., 1871); and "Clinical Lectures on Diseases of the Urinary Organs" (1868; 2d ed., 1870).

**THOMPSON, Joseph Parrish**, an American clergyman, born in Philadelphia, Aug. 7, 1819. He graduated at Yale college in 1838, studied theology at Andover and New Haven, and was ordained pastor of the Chapel street Congregational church, New Haven, in November, 1840. From 1845 to 1872 he was minister of the Broadway Tabernacle church in New York. While at New Haven he was one of the originators of the "New Englander," a Congregational quarterly review, and he was also one of the founders of the "Independent" newspaper. In 1852 he originated the plan of the Albany Congregationalist convention. He was also a manager of the American Congregational union, and of the American home missionary society. In 1852 he visited Palestine, Mt. Sinai, Egypt, and other oriental countries; and he has since devoted much time to oriental studies, especially Egyptology, the results of which have appeared in his contributions to the "North American Review," the "Bibliotheca Sacra," the "Journal of the American Geographical and Statistical Society," Smith's "Dictionary of Biblical Geography and Antiquities," and the revised edition of Kitto's "Cyclopædia of Biblical Literature." Harvard university conferred upon him the degree of D. D. in 1856. He now (1876) resides in Berlin. Dr. Thompson has published "Memoir of Timothy Dwight" (New Haven, 1844); "Lectures to Young Men" (New York, 1846); "Hints to Employers" (1847); "Memoir of David Hale" (1850); "Foster on Missions, with a Preliminary Essay" (1850); "Stray Meditations" (1852; revised ed. entitled "The Believer's Refuge," 1857); "The Invaluable Possession" (1856); "Egypt, Past and Present" (Boston, 1856); "The Early Witnesses" (1857); "Memoir of Rev. David T. Stoddard" (New York, 1858); "The Christian Graces" (1859); "The College as a Religious Institution" (1859); "Love and Penalty" (1860); "Bryant Gray" (1863); "Christianity and Emancipation" (1863); "The Holy Comforter" (1866); "Man in Genesis and Geology" (1869); "Theology of Christ, from His Own Words" (1870); "Home Worship" (1871); "Church and State in the United States" (1874); and "Life of Christ" (1875).

**THOMPSON, Launt**, an American sculptor, born in Queen's county, Ireland, in 1833. He came to the United States at an early age with his mother, a widow, who settled in Albany, N. Y. While studying in the medical college he also attended a drawing school, and was encouraged in his taste for art by William Hart and E. D. Palmer. When the latter opened a studio for sculpture in Albany, Thompson became his pupil, and remained with him nine years, making himself known by his ideal head of "Little Nell," which he twice copied to fill orders, and by his busts and medallion portraits. In 1858 he settled in New York, and was elected an associate of the national academy of design. In 1859 his bust of the "Trapper" secured his election as an academician, and he soon after became a member of the council; and he also served on the committee for the erection of the new building of the academy. He now (1876) resides in Florence, Italy. Among Mr. Thompson's principal works are a statue of Gen. John Sedgwick, erected at West Point; a colossal statue of Napoleon, now owned by Mr. Pinchot of Milford, Pa.; a statue of Gen. Winfield Scott, erected at the soldiers' home near Washington; a soldiers' monument at Pittsfield, Mass.; a statue of the Rev. Abraham Pierson, first president of Yale college, erected in the college grounds; and many busts and bass-reliefs.

**THOMPSON, Thomas Perronet**, an English political reformer, born in Hull, March 15, 1783, died Sept. 6, 1869. In 1803 he entered the navy as midshipman, and in 1806 went into the army as second lieutenant. In 1808 he was made governor of Sierra Leone. One of his first acts was to issue a proclamation for the suppression of the slave trade in the colony; and the opposition raised against him by the slave traders caused his recall. He arrived in England in 1810, returned to the army, and served in the peninsular campaign of 1813, in France in 1814, and afterward in the Pindaree campaign in India. In 1819, having learned Arabic, he accompanied Sir William Keir Grant in the expedition up the Persian gulf, and assisted in the negotiation of the treaty with the Arab tribes, by which the slave trade was declared piracy. In 1854 he was made major general. In 1814 he published a work entitled "On a Constitution." He was one of the contributors to the "Westminster Review" on its establishment in 1824, and five years afterward became joint proprietor, writing for it constantly till 1836. His "Corn Law Catechism" (1827) was the most effective attack upon the protectionist system. He was several times elected to parliament. A selection from his miscellaneous writings was published (6 vols., 1842).

**THOMPSON, Waddy**, an American lawyer, born at Pickensville, S. C., Sept. 8, 1798, died in

Tallahassee, Fla., Nov. 23, 1868. He graduated at the South Carolina college in 1814, and was admitted to the bar in 1819. He was a member of the legislature from 1826 to 1830, when he became solicitor of the western circuit. During the nullification excitement he was elected by the legislature brigadier general of militia (1835). From 1835 to 1841 he was a member of congress, and was prominent in debate as a leader of the whig party. In 1842 he was appointed minister to Mexico. During his mission, he made two important treaties, and procured the liberation of more than 200 Texan prisoners, many of whom were sent home at his own charge. On his return he published "Recollections of Mexico" (8vo, New York, 1846).

**THOMPSONVILLE,** a village in the town of Enfield, Hartford co., Connecticut, 17 m. N. of Hartford; pop. about 3,500. It is on the E. bank of the Connecticut river, and on the New Haven, Hartford, and Springfield railroad. It is chiefly noted for its manufacture of carpets, being the seat of the Hartford carpet company's works, which, according to the latest returns, contain 297 looms and produce 2,600,000 yards annually.

**THOMS, William John,** an English antiquary, born in Westminster, Nov. 16, 1803. He was for some years clerk of printed papers in the house of lords, and in 1862 was appointed sub-librarian of that house. His first separate publication was "A Collection of early Prose Romances" (3 vols., 1828). This was followed by "Lays and Legends of Various Nations" (1834); "Book of the Court" (1838); "Three Notelets on Shakespeare" (1865); and "Hannah Lightfoot, Queen Charlotte, and the Chevalier d'Eon" (1867). He has also edited "Anecdotes and Traditions" (1839), "Stow's Survey of London" (1842), and "Caxton's Reynard the Fox" (1844). His reputation rests principally on the establishment of the periodical "Notes and Queries."

**THOMSON. I. Anthony Todd,** a British physician, born in Edinburgh, Jan. 7, 1778, died at Ealing, Middlesex, July 3, 1849. He was educated at the high school of Edinburgh, studied medicine, in 1798 became a member of the speculative society, and in 1799 of the royal medical society, and in 1800 settled in London as a general practitioner. In 1826 he became a member of the royal college of physicians, in 1828 professor of materia medica in London university, now University college, and in 1832 professor of medical jurisprudence. His works include "The London Dispensatory" (8vo, 1811), and "Elements of Materia Medica" (8vo, 1832), both many times reprinted. **II. Katherine Byerly,** an English authoress, wife of the preceding, born in Etruria, Staffordshire, in 1800, died in Dover, Dec. 17, 1862. She published "Memoirs of the Court of Henry VIII." (2 vols. 8vo, London, 1826); "Memoirs of Sarah, Duchess of Marlborough, and of the Court of Queen Anne" (2 vols., 1839); "Memoirs of the Jacobites of 1715 and 1745" (3 vols., 1845); "Memoirs of the Viscountess Sundon," &c. (2 vols., 1847); "Recollections of Literary Characters and Celebrated Places" (2 vols., 1853); "Court Secrets" (3 vols., 1857); "Life and Times of George Villiers, Duke of Buckingham" (3 vols., 1860); and several novels. "Queens of Society" and "Wits and Beaux of Society" were written with her son, John Cockburn Thomson, under the pseudonymes of Grace and Philip Wharton.

**THOMSON, Charles,** an American patriot, born at Maghera, county Derry, Ireland, Nov. 29, 1729, died at Lower Merion, near Philadelphia, Aug. 16, 1824. He came to America at the age of 11, was educated in Maryland, taught a Friends' academy in Philadelphia, and afterward went into business in that city, and was an intimate friend of Franklin. He was secretary of the continental congress throughout its existence (1774–'88), and of the first United States house of representatives till his resignation in July, 1789. John Adams called him "the Sam Adams of Philadelphia, the life of the cause of liberty." He was the author of "An Enquiry into the Causes of the Alienation of the Delaware and Shawanese Indians" (8vo, London, 1759); a translation of the Bible, the first English version of the Septuagint (4 vols. 8vo, 1808); and "A Synopsis of the four Evangelists" (1815).

**THOMSON, Edward,** an American clergyman, born in Portsea, England, in October, 1810, died in Wheeling, W. Va., March 22, 1870. In 1819 his parents settled in Wooster, Ohio. He graduated in medicine at the university of Pennsylvania in 1829, and in 1833 joined the Ohio Methodist Conference. In 1838 he became principal of Norwalk seminary, Ohio, and in 1844 was elected by the general conference editor of the "Ladies' Repository." In 1845 he became president of the Ohio Wesleyan university at Delaware, Ohio, and in 1860 was elected editor of the "Christian Advocate and Journal." He was elected bishop in 1864, made an extensive tour of missionary observation in Germany, Scandinavia, Bulgaria, India, and China, and organized the Indian missions into an annual conference. He was a member of every general conference from 1840 to 1864. He published "Educational Essays" (new ed., Cincinnati, 1856); "Moral and Religious Essays" (1856); "Biographical and Incidental Sketches" (1856); "Letters from Europe," notes of a tour through England, France, and Switzerland (1856); "Letters from India, China, and Turkey" (2 vols., 1870).

**THOMSON, James,** a British poet, born at Ednam, Roxburghshire, Scotland, Sept. 11, 1700, died at Kew Lane, near Richmond, Aug. 27, 1748. He was the son of a clergyman, and passed six years at the university of Edinburgh, the last four of which were devoted to theological studies. About 1724 he went to London, and for several months was tutor in the family of Lord Binning. A fragment of

blank verse, written by him at the age of 14, was first published in a life of the poet by Allan Cunningham in 1841. He published in March, 1726, his blank verse poem of "Winter," for the copyright of which he received three guineas, and three editions were called for in a year. In 1727 appeared "Summer," followed by "Britannia" and a "Poem sacred to the Memory of Sir Isaac Newton;" in 1728, "Spring;" and in 1730, "The Seasons," completed by the addition of "Autumn," in a 4to volume, of which 454 copies were subscribed for at a guinea each. In 1729 he produced "Sophonisba," a tragedy, acted with moderate success at Drury Lane. In 1731–'2 he travelled on the continent as tutor of the son of Sir Charles Talbot, afterward lord chancellor, and on his return to England commenced an elaborate poem on "Liberty" (5 parts, 1735–'6). It was abridged by Lord Lyttelton in collecting the author's works for publication, and in that condition it still appears. He had meanwhile been placed in easy circumstances by the appointment of secretary of briefs in the court of chancery, bestowed upon him by Lord Talbot. After the death of the chancellor in 1737 he lost the place, but received from the prince of Wales a pension of £100 a year. He now produced successively his dramas "Agamemnon" (1738), which narrowly escaped being damned on the first night, and "Edward and Eleanora," the representation of which was prohibited under the operation of the act for licensing dramatic performances; the masque of "Alfred," written in conjunction with Mallet, which contains the celebrated song and chorus, "Rule Britannia," set to music by Dr. Arne; and "Tancred and Sigismunda," performed with success at Drury Lane in 1745. About this time he was appointed surveyor general of the Leeward islands, the duties of which were discharged by a deputy, while the clear emoluments amounted to £300 a year; and the latter part of his life was passed in an elegant retreat at Kew Lane. In 1748 appeared "The Castle of Indolence," on which he had labored for many years. His posthumous play of "Coriolanus" was performed at Covent Garden. Thomson was a man of gross appearance and exceedingly indolent disposition. The latest edition of his complete works is in two volumes (London, 1870).

**THOMSON. I. James**, a British civil engineer, born in Belfast about 1816. He was educated in Belfast and Glasgow, where his father was professor of mathematics. He took the master's degree in 1840, studied civil engineering and mechanics, became a pupil in the Horseley iron works, near Tipton, South Staffordshire, entered the service of William Fairbairn, and afterward settled in Belfast as a civil engineer. In 1857 he was appointed professor of civil engineering in Queen's college, Belfast, and in 1872 professor of engineering and mechanics in the university of Glasgow. Prof. Thomson has been prominently employed as a consulting engineer for water supply, irrigation, and other agricultural engineering. He invented the vortex turbine, and the jet pump and intermittent reservoir, for draining swamp lands. His investigations of the lowering by pressure of the freezing temperature of water suggested the perfect solution of the problem of glaciers. About 40 papers by him on physics, mathematics, and mechanics have been published in the "Cambridge and Dublin Mathematical Journal," the "Edinburgh Philosophical Journal," the "Transactions" of the royal societies of London and Edinburgh, the "Proceedings" of the British association, and the "Transactions" of the institution of engineers of Scotland. **II.** Sir **William**, a British mathematician, brother of the preceding, born in Belfast in June, 1824. He studied in Glasgow university, and afterward at Cambridge, where he graduated in 1845, and became a fellow of St. Peter's. In 1846 he was made professor of natural philosophy in Glasgow university, which post he still holds (1876). For seven years he was editor of the "Cambridge and Dublin Mathematical Journal," among his contributions to which was one on "Distribution of Electricity on Spherical Conductors" (1848). In 1855 he delivered the Bakerian lecture on "Electrodynamic Properties of Metals." He has constructed several beautiful instruments for the study of electrical phenomena, and is at present engaged in perfecting a tide-calculating machine. He invented the mirror galvanometer and syphon recorder, for ocean telegraphy, which, owing to their extreme delicacy, can be worked by very low battery power. He has made important contributions to the science of magnetism, and investigated the laws of heat. (See Heat.) He was knighted in 1866. Among his published papers are "Thermal Effects of Fluids in Motion," "The Mathematical Theory of Elasticity," and "The Rigidity of the Earth." A volume of his papers on electrostatics and magnetism appeared in 1872.

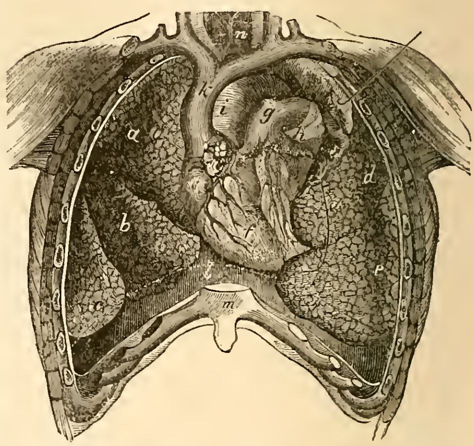
**THOMSON, Thomas**, a British chemist, born at Crieff, Perthshire, April 12, 1773, died at Kilmun, Argyleshire, July 2, 1852. He was educated at the university of St. Andrews and at Edinburgh, and in 1796 became a contributor to the "Encyclopædia Britannica," his chemical articles in which formed the basis of his "System of Chemistry" (4 vols. 8vo, 1802). He was one of the first to suggest the use of chemical symbols, and among the first to elucidate the atomic theory of Dalton. In 1810 he published the "Elements of Chemistry" (8vo); in 1812, the "History of the Royal Society of London" (4to); and in 1813, "Travels in Sweden," which country he had visited in the previous year. In 1813 he went to London and commenced the "Annals of Philosophy," which he edited till 1822. In 1817 he was chosen lecturer at the university of Glasgow, and in 1818 was made professor of chemistry. His other works are: "An Attempt to Establish

the First Principles of Chemistry by Experiment" (2 vols., 1825); "The History of Chemistry" (2 vols., 1830-'31); "Outlines of Mineralogy and Geology" (2 vols., 1836); and "Brewing and Distillation" (1849).—His son Thomas, superintendent of the East India company's botanic gardens at Calcutta, has published an account of his travels in the western Himalaya and Thibet (8vo, 1852).

**THOMSON, William,** an English clergyman, born in Whitehaven, Feb. 11, 1819. He was educated at Queen's college, Oxford, of which he was successively fellow, tutor, and provost. He was ordained in 1842, became select preacher at Oxford in 1846, Bampton lecturer in 1853, rector of All Souls, Marylebone, in 1855, preacher of Lincoln's Inn in 1858, bishop of Gloucester and Bristol in 1861, and archbishop of York in 1863. He has published "The Atoning Work of Christ" (London, 1853); "Outline of the Necessary Laws of Thought," a text book in several English and American colleges (1842; 9th ed., 1868); "Life in the Light of God's Word" (1867); "Limits of Philosophical Inquiry" (1868); and sermons, pastoral letters, and lectures.

**THOR,** in Scandinavian mythology, the first born of Odin and Frigga, the bravest and boldest of all the gods. He directed the winds and the seasons; agriculture and the family relations were under his special care; and, unlike Odin, he was opposed to war among men. In the Eddas he appears as the champion of gods and men, destroying monsters and giants with his bolts of thunder. A terrible hammer was hurled at his victim, and after the blow was dealt the weapon returned to his hand. His waist was bound with a girdle which forever renewed the strength he spent in battle. Thor has been compared with Hercules, Jupiter, and the old Saxon deity Irmin. The fifth day of the week has from him received its name, Thursday.

**THORAX** (Gr. θώραξ), the chest, or upper part of the trunk of the body, situated between the neck and the abdomen. The osseous framework of the thorax consists of the 12 dorsal vertebræ behind, the sternum or breast bone in front, and the ribs upon each side. The spaces between the ribs are occupied by the intercostal muscles, external and internal. The floor or inferior wall of the thorax is constituted by the diaphragm, a vaulted muscular sheet, with a central tendinous expansion, the convexity of which looks upward toward the chest, while its concavity looks downward toward the abdomen. The general form of the thorax is conical, with a broad base below, and presenting at its upper extremity a comparatively narrow and nearly circular opening, bounded on each side by the curved borders of the first pair of ribs, through which the trachea, œsophagus, nerves, and blood vessels pass from the neck into the chest, or *vice versa*. The framework of the chest thus constituted has a considerable degree of elasticity, owing to the curved form of the ribs themselves, and to the fact that they are articulated with the sternum by elastic cartilages of variable length, oblique in position. Owing to the mobility of the ribs at their vertebral articulations, they are capable of being rotated outward and elevated by the action of the intercostal muscles, and of thus expanding the cavity of the chest laterally. The expansion also takes place at the same time in an antero-posterior direction, since the sternum itself is elevated by the movement of the ribs and carried further away from the spinal column; in this way is produced the alternate rising and falling of the walls of the chest during respiration. By the contraction of the diaphragm the central tendon of this muscle is drawn downward at the moment of inspiration, thus also expanding the chest vertically.—The cavity of the thorax has a general conoidal form, corresponding with




Cavity of the Thorax in Man, opened anteriorly, showing the internal organs. *a*, *b*, *c*. Upper, middle, and lower lobes of the right lung. *d*, *e*. Upper and lower lobes of the left lung. *f*. Heart. *g*. Pulmonary artery. *h*. Pulmonary vein. *i*. Aorta. *k*. Superior vena cava. *l*. Upper surface of the diaphragm. *m*. Lower extremity of the sternum. *n*. Trachea.

its external configuration. It is partially divided, however, into lateral halves by the forward projection of the bodies of the dorsal vertebræ, leaving on each side of the spinal column a tolerably deep rounded groove or furrow. The principal organs contained in the cavity of the thorax are the heart, lungs, and great blood vessels. The heart is situated nearly in the median line, with its point directed downward and toward the left side, and the lower part of its inferior and posterior surface resting upon the central tendon of the diaphragm. The superior and inferior venæ cavæ, the aorta, the pulmonary artery, and the pulmonary veins are connected with the base of the heart, mostly about the level of the junction of the third costal cartilage with the sternum. The lungs are on each side, moulded to the form of the cavity in which they are contained, and

partly lapping over the heart and great vessels in an anterior view. The trachea enters the cavity of the chest behind the superior vena cava and the arch of the aorta, and the œsophagus is situated still further backward, in immediate contact with the spinal column. The phrenic nerve passes down on each side, between the subclavian artery and vein, in front of the root of the lung, between the pleura and pericardium, to be distributed to the muscular tissue of the diaphragm. The pneumogastric nerves descend behind the roots of the lungs, where they give off their pulmonary branches, and then accompany the œsophagus through an opening in the diaphragm to the stomach. The thoracic portion of the great sympathetic nerve is on each side of the spinal column, as a chain of ganglia, each ganglion resting upon the head of a rib, and connected by nervous filaments with those above and below.

**THOREAU, Henry David,** an American author, born in Concord, Mass., July 12, 1817, died there, May 6, 1862. He graduated at Harvard college in 1837, and after teaching school for a short time became a land surveyor. In this pursuit he worked no more than was necessary to gain the means for his simple wants, and devoted most of his time to reading, writing, pedestrian excursions, and study. Emerson says of him: "Few lives contain so many renunciations. He was bred to no profession; he never married; he lived alone; he never went to church; he never voted; he refused to pay a tax to the state; he ate no flesh, he drank no wine; he never knew the use of tobacco; and, though a naturalist, he used neither trap nor gun." In 1845 he built a small frame house on the shore of Walden pond, Concord, and lived in it alone for two years, working and studying. He published "A Week on the Concord and Merrimack Rivers" (Boston, 1849), and "Walden, or Life in the Woods" (1854). After his death were published "Excursions in Field and Forest," with a biographical sketch by R. W. Emerson (1863); "The Maine Woods" (1864); "Cape Cod" (1865); "Letters to Various Persons," with nine poems (1865); and "A Yankee in Canada," with anti-slavery and reform papers (1866).—See "Thoreau, the Poet-Naturalist," by William Ellery Channing (Boston, 1873).

**THORIUM,** or **Thorinum,** a rare metal discovered in 1828 by Berzelius in a black mineral called thorite, found in a syenitic rock in Norway. It is obtained by reducing the chloride with potassium or sodium. It is a gray metallic powder having much resemblance to zirconium, and acquires a metallic lustre by pressure. Its specific gravity is 7·6 to 7·8; symbol, Th. It takes fire when heated considerably below redness, and burns with great brilliancy, forming thorina, $ThO_2$, a white substance of sp. gr. 9·402. Thorinic chloride, $ThCl_2$, is prepared by passing dry chlorine over a heated mixture of thorina and charcoal. It crystallizes in rectangular four-sided tables, which are deliquescent and very soluble in water. Thorinic sulphate, with potassic sulphate, forms thorinic potassic sulphate, $K_2SO_4,ThSO_4,H_2O$, which is soluble in water, but is precipitated by a saturated solution of potassic sulphate. Thorinic sulphate is characterized by being precipitated by boiling its solution, which redissolves on cooling. Oxalic acid gives with salts of thorium a white insoluble oxalate of the metal.

**THORN,** a name used in combination for various spinescent plants, but by itself restricted to species of the genus *cratægus*, of the rose family. The genus belongs to that division of the family (tribe *pomeæ*) which includes *pyrus*, the apple, pear, &c., and differs from this chiefly in the structure of the fruit. About 65 species are described (which is probably many more than really exist), found in Europe, Asia, and North America, and a single one in the Andes of Columbia; they are shrubs, or sometimes small trees, and often armed with thorns, which are abortive or suppressed branches. The leaves are alternate, simple, often lobed, and in some species evergreen; the abundant flowers, usually in terminal clusters, though much smaller, closely resemble those of the apple in structure, are generally white, sometimes rose-colored, and fragrant; styles one to five; the usually red and sometimes edible fruit is a drupe rather than a pome; the carpels, instead of being parchment-like as in the apple, forming when ripe a hard, bony, one- to five-celled stone, or one to five distinct, bony, one-seeded stones. There are about a dozen species of thorn in the Atlantic states, three or four of which are peculiarly southern, and two naturalized; a few of the native species extend across the continent, and a small number are peculiar to the far west. In their wild state, as well as in cultivation, the species are much disposed to vary.—One of the most noticeable and finest of the native species is the cockspur thorn (*cratægus crus-galli*), which extends from Canada to Florida and west of the Mississippi. When well developed it is a small tree, 10 to 20 ft. high, with numerous nearly horizontal branches forming a round head; the sharp and slender thorns are 2 to 4 in. long, and often show their branch-like nature by bearing leaves when young; the obovate leaves taper to a wedge-shaped base, are serrate toward the apex, very thick, smooth, dark green, and shining above, 1½ to 2 in. long; the flowers, produced on spurs shorter than the thorns, are succeeded by bright red, nearly globular fruit, about half an inch in diameter. This produces in the wild state varieties differing much in their foliage, and its synonymes are numerous; there are also some garden varieties, one of them remarkably dwarf. It was introduced into England nearly 200 years ago, and is there valued as an ornamental shrub or small tree; experiments have been made with it here as a hedge plant, to which use it is perhaps better

adapted than any other native thorn, but it has the disadvantages common to plants of this genus mentioned under HEDGE. The hard close wood of this and other species takes a

Cockspur Thorn (Cratægus crus-galli).

fine polish, and serves for handles to hammers and other tools, but on account of its small size its use is limited. Among the most conspicuous of the native species is the Washington thorn (*C. cordata*), which grows from Virginia southward, but has been somewhat cultivated as a hedge plant further north; it grows 10 to 20 ft. high, and is very spiny; its broad leaves, sometimes slightly heart-shaped at base, are often three-lobed; the fruit, the size of peas, is bright red. The scarlet-fruited thorn (*C. coccinea*), with smooth, thin, roundish-ovate leaves, and coral-red but scarcely edible fruit, is very common. So also is the pear or black thorn (*C. tomentosa*), which has thickish ovate or obovate, sharply toothed leaves, downy when young, very large fragrant flowers, and globular or pear-shaped fruit three fourths of an inch across, scarlet or orange, and edible, having often a pleasant flavor; there are several varieties of this, one of which has its fruit dotted with white. The parsley-leaved thorn (*C. apiifolia*), distinguished by its much cut leaves, is found from Virginia southward. The summer haw (*C. æstivalis*) of South Carolina, and growing southward and westward, is a small tree found on the margins of the pine-barren ponds; it has wedge-obovate, thick leaves, and globose, large, red fruit, which ripens in early summer, and, being quite juicy with a pleasant acid flavor, is much esteemed for making tarts and jellies. The remaining native species are only of interest to the botanist.—Among exotic thorns, the best known is the hawthorn (*C. oxyacantha*), also called white thorn, and in England May or May tree, and also quickset, from its being set to form a quick or living fence or hedge. The term haw is applied to the fruit of this and other thorns; but being from the A. S. *haga*, a fence or hedge, hawthorn really means a hedge thorn, and the origin of the name points to this use of it in very early times. The species is found throughout Europe, Siberia, and central Asia; and as it was early introduced into this country, it has become more or less naturalized in the older states. Its smooth leaves are wedge-shaped at the base and cut-lobed and toothed above; its abundant flowers appear in May, and are followed by ovoid, coral-red, rather small fruit. The varieties are numerous, the catalogues containing 30 or more, which differ from the normal form in the shape of the tree, some being very pendulous, in the character of the leaves, and in the form and color of the flowers; the bloom, usually white, varies from blush through pink and rose color up to a recently introduced scarlet, and there are double as well as single flowers of the white and various shades, so that a collection of the forms of this species alone would present a great variety. The Glastonbury thorn, near the abbey of that name in England, is a variety of hawthorn flowering twice a year; it blooms at the usual time, and also bears a crop of very early flowers, which open about Christmas. In England the hawthorn is the almost universal hedge plant, it being as well adapted to that climate as it is unfitted to ours; the early attempts at hedging in this country were, in imitation of the home practice, made with this plant; and the general

Hawthorn (Cratægus oxyacantha).

failure with it brought all hedging into disrepute. (See HEDGE.) The evergreen or pyracanth thorn (*C. pyracantha*), from the south of Europe, was distributed several years ago as a desirable hedge plant; it has shining, evergreen, mostly oblong leaves, about an inch long, with small clusters of flowers and brilliant red fruit; it has become naturalized near Washington and in some other localities; in a climate not more severe than that of Virginia it makes an excellent hedge. An accidental variety with white or yellowish fruit is (as is sometimes the case with varieties) more robust

than the type; this has proved perfectly hardy near New York in the most severe winters, and promises to be a valuable hedge plant.—The pyracanth thorn is readily multiplied from cuttings, but the hawthorn and our native species are mostly raised from seeds, which are very slow in germinating; the fruit is placed in what is called the "rot heap," where mixed with earth it is exposed to the weather for a year before sowing. Thorns from the seed are used as stocks upon which to graft the double and other desirable varieties, and some of our vigorous native species have been used as stocks for the pear; but there is no advantage in using these stocks, and unless the grafting is done below the surface of the soil the pear is apt to break away from the thorn.

**THORN,** a town of the kingdom and the province of Prussia, on the right bank of the Vistula, 52 m. S. W. of Marienwerder; pop. in 1871, 16,619. It has three Protestant and three Catholic churches, famous manufactories of gingerbread, and an important trade in corn and lumber. It is the birthplace of Copernicus, of whom there is a statue in the market place and a monument in the Catholic St. John's church. It is strongly fortified.—Thorn was founded about 1230 by the Teutonic knights. It joined the Hanse league, and in 1454 placed itself under the protection of Poland, to which it was confirmed by the peace with the order concluded there in 1466. In 1724 a riot between the students of the Protestant gymnasium and those of the Jesuit school led to a bloody persecution of the Protestant citizens. Thorn has repeatedly been besieged.

**THORN APPLE.** See DATURA.

**THORNBURY, George Walter,** an English author, born in London in 1828, died June 11, 1876. In 1845 he published a series of topographical and antiquarian papers in the "Bristol Journal." After 1858 he abandoned the name George. He published "Lays and Legends, or Ballads of the New World" (London, 1851); "Monarchs of the Main, or Adventures of the Buccaneers" (1855); "Shakespeare's England," and "Art and Nature at Home and Abroad" (1856); "Legend of the Wandering Jew," and "Songs of the Cavaliers and Roundheads" (1857); "Every Man his Own Trumpeter," a novel founded on Montluc's memoirs (1858); "Life in Spain, Past and Present" (1859); "Turkish Life and Character" (1860); "British Artists from Hogarth to Turner" (2 vols. 8vo, 1860); "Ice-Bound," "Cross Country," and "Life of J. M. W. Turner, R. A." (1861); "True as Steel" (1863); "Wildfire" (1864); "Haunted London," and "Tales for the Marines" (1865); "Greatheart, a Cornish Novel" (1866); "Two Centuries of Song," a collection of *vers de société* (1867); "The Vicar's Courtship," and "Old Stories Retold" (1869); "A Tour round England" (1870); "Old and New London" (2 vols., 1873–'4); and "Historical and Legendary Ballads and Songs," a collection of his previously published poems (1876).

**THORNHILL, Sir James,** an English painter, born in Weymouth in 1676, died there, May 4, 1734. He settled in London, and during the last 30 years of his life was employed on important works, including the eight pictures in chiaroscuro illustrating the history of St. Paul on the inner dome of St. Paul's cathedral, and the decorations at Kensington palace, Blenheim, and Greenwich hospital. In 1724 he opened an academy for drawing at his house. Hogarth was his pupil and son-in-law. He was knighted by George I., and represented Weymouth in parliament.

**THORNTON, Bonnell,** an English author, born in London in 1724, died May 9, 1768. He was educated at Oxford, and in conjunction with George Colman the elder began a periodical, "The Connoisseur," which lasted from January, 1754, to September, 1756. With Colman also he was one of the original proprietors of "The St. James's Chronicle." In 1762 he published "An Ode on St. Cecilia's Day, adapted to the antient British Music, viz., the Salt-box, the Jews-harp, the Marrow-bones and Cleavers, the Hum-strum or Hurdy-gurdy, &c., with an Introduction giving an Account of those truly British Instruments" (4to, London); the ode was set to music by Dr. Burney, and performed on the instruments named with great success. In conjunction with Colman and Richard Warner he published "The Comedies of Plautus, translated into familiar Blank Verse" (2 vols., 1767), of which he translated "Amphitryon," "The Braggart Captain," "The Treasure," "The Miser," and "The Shipwreck." In 1768 he published "The Battle of the Wigs, an additional Canto to Dr. Garth's Poem of the Dispensary" (4to).

**THORNTON, Matthew,** a signer of the Declaration of Independence, born in Ireland in 1714, died in Newburyport, Mass., June 24, 1803. His father emigrated to America about 1717. The son was educated at Worcester, Mass., studied medicine, and commenced practice at Londonderry, N. H. In 1745, as a surgeon, he joined a New Hampshire division of 500 men in the expedition against Louisburg. At the beginning of the revolutionary war Dr. Thornton was a colonel in the militia. When a provincial convention was called, he was chosen its president; but he was immediately appointed to represent New Hampshire in the congress, and was permitted to sign the Declaration of Independence after taking his seat in September, 1776. Subsequently he was chief justice of the court of common pleas in New Hampshire, and later a judge of the superior court. He removed from Londonderry to Exeter, and finally fixed his residence at Merrimack, where he purchased a large estate.

**THORNWELL, James Henley,** an American clergyman, born in Marlborough district, S. C., in 1811, died in Charlotte, N. C., Aug. 1, 1862. He graduated at the South Carolina college in 1829, studied theology, and commenced preaching as a Presbyterian minister to the Waxhaw

church. In 1836 he was elected professor of logic and belles-lettres in the South Carolina college, and in 1838 became pastor of the Presbyterian church in Columbia. In 1840 he accepted the professorship of the evidences of Christianity and the chaplaincy of the college, and in May, 1852, took charge of the Glebe street church, Charleston. In December, 1852, he was elected president of the college, and in 1856 resigned to take a professorship in the Presbyterian theological seminary at Columbia. He published "Arguments of Romanists Discussed and Refuted" (New York, 1845); "Discourses on Truth" (1854); "On the Rights and Duties of Masters," and "The State of the Country" (1861); and numerous controversial articles in the "Southern Presbyterian Review," defending slavery and secession. His collected works have been edited by the Rev. John B. Adger (2 vols. 8vo, Richmond, 1874).

**THORNYCROFT, Mary** (Francis), an English sculptress, born at Thornham, Norfolk, in 1814. She was a pupil of her father, John Francis (1780–1861), who attained great eminence in London as a portrait sculptor, and executed busts of Queen Victoria, Prince Albert, Wellington, and many of the statesmen of his time. In 1840 she married Mr. Thornycroft, also a pupil of her father, and in 1842 accompanied him to Rome, where she received instructions from Thorwaldsen and Gibson. After her return in 1843 she was employed to execute statues of four of the royal children in the character of the four seasons. Her works include "The Flower Girl," "Sappho," "Sleeping Child," and "Girl Skipping."

**THOROUGH BASS,** the art by which harmony is superadded to any proposed bass, such harmonies being indicated by figures placed under the bass notes. The term is also used like counterpoint as synonymous with the science of harmony. (See Music, vol. xii., p. 81.)

**THOROUGHWORT.** See Boneset.

**THORPE, Benjamin,** an English philologist, born about 1808, died at Chiswick, July 18, 1870. He devoted himself to the study of Anglo-Saxon, translated the Anglo-Saxon grammar of Rask, superintended a series of editions of Anglo-Saxon works, including the metrical paraphrase of the Bible by Cædmon (1832), and published *Analecta Anglo-Saxonica* (1834); "The Anglo-Saxon Version of the Story of Apollonius" (1834); *Libri Psalmorum Versio Antiqua Latina, cum Paraphrasi Anglo-Saxonica* (1835); the great collection entitled "Ancient Laws and Institutes of England, with a Compendious Glossary," &c. (1840); *Codex Exoniensis* (1842); "Northern Mythology" (3 vols., 1851–'3), a critical collection of the legends of Scandinavia and northern Germany; "The Anglo-Saxon Chronicle" (2 vols. 8vo, 1861); and *Diplomaticum Anglicum Ævi Saxonici*, a collection of English charters (1865).

**THORWALDSEN, Bertel,** a Danish sculptor, born at sea between Iceland and Denmark, Nov. 19, 1770, died in Copenhagen, March 24, 1844. He was the son of an Icelander, who was a wood carver, and was christened Bartholomæus, but was called by the diminutive Bertel, which the Italians turned into Alberto. At the age of 11 he entered the free school of the academy of arts in Copenhagen. At 17 he gained the silver medal of the academy; at 20 the small gold medal for his "Heliodorus driven from the Temple;" and in 1793 the grand prize, which entitled him to a small stipend for studying abroad. For several years after his arrival in Rome (March 8, 1797), his progress, owing to illness and his own diffidence, received no adequate recognition. He was preparing in 1803 to return to Denmark, when his model of "Jason bearing the Golden Fleece" attracted the notice of Thomas Hope, who offered him a liberal sum for the execution of the statue in marble, which reached England only in 1824. His earliest efforts reflected the idealism of classic art, and his Mars, Mercury, Ganymede, the Graces, Venus, Cupid and Psyche, Hector and Priam, and "Dance of the Muses on Mount Helicon" are among the best modern imitations of the antique. A more important work was the magnificent bass relief of the "Triumphal Entry of Alexander into Babylon," the plaster cast of which was completed in 1812 by order of Napoleon, for the Quirinal. Two copies in marble are in existence, one of which is in the palace of Christiansborg, Copenhagen. As Thorwaldsen gained in confidence and executive power, he rose above the mere imitation of Greek sculpture, and devoted himself to original works. In 1819 he made a brief visit to Copenhagen. His progress thither through Italy and Germany was one continuous ovation, and on arriving at his native city he was escorted in triumph to apartments prepared for him in the royal palace of Charlottenborg. Returning to Rome in 1820, he began the series of religious works which stamp him as one of the regenerators of sculpture. Among these was his colossal group of "Christ and the Twelve Apostles," now in the cathedral church of Copenhagen. In the same church are his statues of the four great prophets and many fine bass reliefs, and the exterior is adorned by his frieze of "Christ bearing the Cross," and by a group in alto rilievo representing the "Preaching of St. John," which fills the pediment. He also executed seated statues of Galileo, of Copernicus, in Warsaw, and of Byron, in Trinity college library, Cambridge; a monument to Pius VII.; and a vast number of other works. His largest single work is the colossal lion near Lucerne, Switzerland, commemorating the Swiss guards who fell in defending the Tuileries, Aug. 10, 1792; and among his statues in bronze are those of Schiller at Stuttgart and Gutenberg at Mentz. In 1838 he returned to Copenhagen in a frigate furnished him by the government, and was lodged in the royal palace. He died suddenly

of disease of the heart, just after he had taken his seat in the theatre. He was engaged until within a few hours of his death upon a bust of Luther, which was left unfinished. He was a man of much modesty, generosity, and amiability. As a sculptor of bass relief he surpassed any of his contemporaries; and some of his smaller works in this department, as the "Day" and "Night," modelled in 1815 at a single sitting, display a fertile vein of poetic imagination and executive refinement. In other works of the class he neglected the execution for the purpose of attaining vigor and strength. His entire collection of works of art, and the bulk of his large personal property, were bequeathed to the city of Copenhagen for establishing and supporting the celebrated museum containing his mausoleum and marble or plaster copies of all his works, of which Holst published 120 lithographs in his *Musée Thorvaldsen* (Copenhagen, 1851). Eugène Plon established in 1874 a Thorwaldsen museum at the Louvre.—See Thieler's various works on Thorwaldsen, including his life collated from his autobiography (German, Leipsic, 1852–'6; English translation by the Rev. M. R. Barnard, London, 1865), and Eugène Plon's *Thorvaldsen, sa vie et son œuvre* (Paris, 1867; English translation by Mrs. Cashel Hoey, London, 1874, and by Miss I. M. Luyster, Boston, 1874).

**THOU, Jacques Auguste de** (Lat. Thuanus), a French historian, born in Paris, Oct. 8, 1553, died May 7, 1617. He was the son of a first president of the parliament of Paris, studied law at home and in Italy, and was early engaged in diplomatic and judicial employments. In 1588 he was one of the deputies to the states general at Blois. He aided in effecting a reconciliation between Henry III. and Henry of Navarre, and went to Germany and Italy to procure men and money for them. Henry IV. appointed him grand master of the royal library, and in 1594 *président à mortier* of the parliament of Paris. He was one of the framers of the edict of Nantes, and supported the rights of the Gallican church by preventing the adoption of several decrees of the council of Trent. On the death of Henry IV. he was appointed one of the directors of finance. His *Historia sui Temporis* (completed from his materials by Père Dupuy and Nicolas Rigault in a 7th ed., 1620) embraces the period from 1543 to 1607, in 138 books. The only complete edition of his works is that of S. Buckley and T. Carte (7 vols. fol., London, 1733), including besides the above his autobiography, letters, and various essays, with an appendix by Rigault continuing the history to the death of Henry IV. A French translation appeared in 1734, in 16 vols. 4to, and a new edition of his autobiography in French, by Masson, in 1838. De Thou also left some Latin poems: *Hieracosophion, sive de Re Accipitraria Libri III.* (4to, 1584); *Poemata Sacra* (12mo, 1599); and *Posteritati*, &c. (12mo, 1678).—See "Life of Thuanus, with some Account of his Writings," by the Rev. John Collinson (London, 1807), and *Discours sur la vie et les ouvrages de J. A. de Thou*, by Philarète Chasles (Paris, 1824).—His son, François Auguste, who succeeded him in the royal library, was a friend of Cinq-Mars, and was executed with him, Sept. 12, 1642.

**THOUARS.** See Du Petit-Thouars.

**THRACE,** in ancient geography, originally that part of modern Turkey in Europe lying between the Danube, the Black sea, the sea of Marmora, the Grecian archipelago, the Struma, and a line, not well defined, connecting that river with the Danube. In later times that part of Thrace which lay between the rivers Strymon (now Struma) and Nestus (Kara-su) was annexed to Macedonia by Philip, and the country N. of the Hæmus (Balkan) was made by the Romans a separate province under the name of Mœsia. Thrace, in the narrowest sense, was bounded N. by the Hæmus, E. by the Euxine, S. E. and S. by the Thracian Bosporus, the Propontis, the Hellespont, and the Ægean sea, and W. by the Nestus. Two offshoots of the Hæmus, the Rhodope (Despoto Dagh), E. of the Nestus, and a parallel range near the Euxine, traversed it in a S. E. direction. It was watered, besides the Nestus, by the Hebrus (Maritza) and its affluents the Artiscus (Tundja), Agrianes (Erkeneh), and others. The principal towns were Apollonia and Salmydessus on the Euxine; Byzantium (Constantinople) on the Bosporus; Selymbria and Perinthus or Heraclea (Erekli) on the Propontis; Callipolis (Gallipoli) and Sestos on the Hellespont, in the Thracian Chersonesus (peninsula of Gallipoli); Lysimachia, Ænos, Mesembria, Maronea, and Abdera, on the Ægean; and Philippopolis, Hadrianopolis (Adrianople), and Trajanopolis, on the Hebrus. The towns on the coast were all Greek settlements. The district between the Strymon and Nestus, called Macedonia Adjecta, contained Neapolis, Philippi, and Amphipolis. In the times of Herodotus and Thucydides, Thrace, in the wider sense, was peopled by numerous tribes, probably Goths and Scythians, as Getæ, Treres, Odrysæ, Triballi, Daci, and Mœsi. At an early period they seem to have greatly influenced the culture of the Greeks, especially their mythology and religious rites. They are described as powerful, warlike, and cruel. They worshipped deities identified with Mars, Bacchus, and Diana, and had an oracle of Bacchus on a lofty summit of Rhodope. Orpheus, Linus, Musæus, and Eumolpus are said to have been Thracians. We find fragments of the Thracian race also in parts of Asia Minor and central Greece.—The Thracians are said to have been conquered by the Teucrians and Mysians. They were subdued by the Persians under Darius, but recovered their freedom after the reverses of Xerxes. Their most powerful native rulers were Sitalces, king of the Odrysæ, who fell in battle against the Triballi in 424 B. C., and his nephew Seuthes, after

whose death the Thracian kingdom was split up in parts. Philip of Macedon conquered the greater part of it, and after the death of Alexander it was ruled by Lysimachus. It was subsequently annexed to Macedonia, and finally, with the latter, to the Roman dominions, though it long continued to be governed by native chiefs. After the division of the Roman empire it shared the fate of the eastern part. Its main parts now form the vilayet of Edirneh (Adrianople). (See ROUMELIA.)

**THRALE.** See PIOZZI.

**THRASHER.** See THRUSH.

**THRASYBULUS,** an Athenian general, attached to the democratic party, died about the close of 390 B. C. In 411 he was in command of an Athenian galley in the fleet at Samos, and joined the opponents of the oligarchical government of the 400. He was soon after made a general by an assembly in the camp, and procured the pardon and recall of Alcibiades. At the battle of Cynossema he commanded the right wing, and secured the victory by a sudden attack upon the Peloponnesians. In 407, with a fleet of 30 ships, he reduced most of the revolted cities on the coast of Thrace to submission, and about the same time was with Alcibiades elected one of the new generals. Banished on the establishment of the thirty tyrants, he seized with the aid of some Thebans the fortress of Phyle, and with 1,000 men occupied Piræus. From this place he carried on a brisk warfare against the thirty, and the ten who succeeded them, and finally delivered Athens and restored the democratic government (403). In 395 he led an army to the assistance of the Thebans, then menaced by Sparta, and in 390 was sent with 40 ships to aid the Rhodians against Teleutias, restored the Athenian interest in Byzantium, secured several new alliances, and reduced Methymna and other towns in Lesbos. Afterward sailing south, he anchored in the Eurymedon, near Aspendus in Cilicia, when the inhabitants, exasperated by some act of his soldiers, killed him in the night.

**THRASYMENUS, or Trasimenus, Lake.** See PERUGIA, and HANNIBAL.

**THREAD WORM.** See ENTOZOA, vol. vi., p. 670.

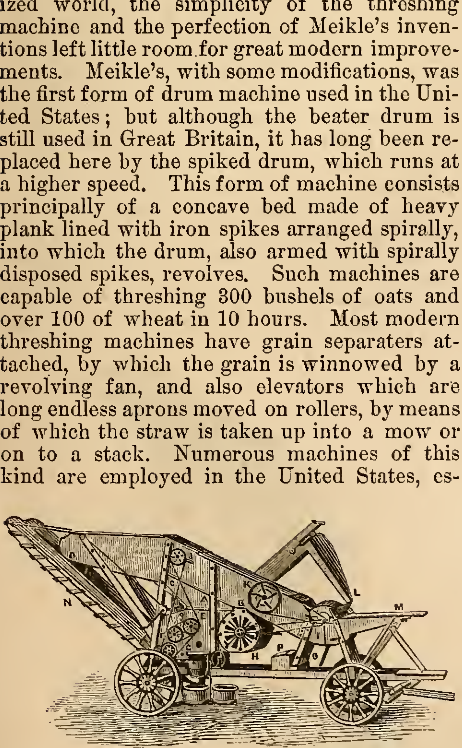
**THREATENING LETTERS,** sent to persons for the purpose of extorting money, have been said to constitute a misdemeanor or criminal offence at common law. Blackstone says that threatening by letter (even without demand) to kill any of the king's subjects or to fire their houses, &c., was made high treason by a statute of Henry VIII.; and though this is no longer the law, the offence is punishable severely under existing statutes. In many of the United States there are statutory provisions, punishing with great severity an attempt to extort money by means of a threatening letter. It may be said generally that a threat, to be indictable, must be such as might naturally overcome a man of ordinary firmness and sagacity; and the money demanded under the threat must be money to which the sender of the letter has no right. In England, it would seem to be an offence at law to post up, on a placard or otherwise, a threatening notice.

**THREE RIVERS** (Fr. *Trois Rivières*), a city and port of entry of the province of Quebec, Canada, on the N. bank of the river St. Lawrence, at the mouth of the St. Maurice, 62 m. S. W. of the city of Quebec and 80 m. N. E. of Montreal; pop. in 1861, 6,058; in 1871, 7,570. It is connected by ferry with a branch of the Grand Trunk railway on the opposite bank of the St. Lawrence. The chief trade is in lumber, which is shipped in large quantities to South America, the West Indies, England, and the United States. The value of imports for the year ending June 30, 1874, was $82,-097; of exports, $159,451. An additional element of prosperity is the manufacture of iron wares, for which the St. Maurice forges, 3 m. distant, are noted. The city contains two branch banks, a college, an English academy, an Ursuline convent and school, several other schools, a tri-weekly and a semi-weekly newspaper (both French), a Roman Catholic cathedral and parish church, and Episcopal, Presbyterian, and Wesleyan Methodist churches. The streets are lighted with gas.—Three Rivers was founded in 1618. With the parish of the same name it forms an electoral district for parliamentary purposes, having an area of 17½ sq. m. and 8,414 inhabitants in 1871.

**THRESHER.** See SHARK, vol. xiv., p. 829.

**THRESHING MACHINE,** a machine for threshing and separating grain from the straw. The threshing floor of the ancients was a flat surface of ground covered with clay rolled smooth and hard. Sheaves of grain were spread evenly on this floor, and cattle driven over it until the grain was beaten out by the constant tramping upon it. The Egyptians usually muzzled the ox while threshing, and the Greeks are said by Ælian to have had the filthy practice of besmearing the mouths of animals with dung to prevent their eating the grain. The flail, which is yet in common use by small farmers, is a very ancient invention. Planks or timbers stuck over with pieces of flint or hard wooden pegs were used to some extent, but answered no good purpose. Michael Menzies of Scotland is supposed to have been the first inventor of a machine for threshing, which was merely an adaptation of suitable mechanism to drive a large number of flails by water power. Though unsuccessful in practice, this machine attracted considerable attention. In 1758 a Stirlingshire farmer named Leckie invented a rotary machine which consisted of a set of cross arms attached to a horizontal shaft, and the whole enclosed in a cylindrical case. It proved tolerably efficient in threshing oats, but was not adapted to wheat, as it knocked off the entire head from the straw without separating the kernels. Mr. Leckie having demonstrated the superiority of

a rotary motion for this purpose, it was an easy matter to remedy the defects of his machine and perfect the invention. In 1786 Andrew Meikle, a Scotchman, made an improvement on Leckie's machine by substituting a drum or cylinder with beaters attached to the circumference. He also applied rollers, connected by suitable mechanism to the driving gear, for feeding in the straw. When operated, the drum was set in rapid motion by water or other power; the sheaves of grain, unbound and placed between the rollers, were fed in; and the beaters, revolving with great velocity on the periphery of the drum, beat out the grain from the heads and partially separated it from the straw. A patent was procured in Great Britain in 1788, when Mr. Meikle constructed the first working machine, and added many new improvements, among which was the attachment of a fan mill, by which the grain was separated and cleaned from both straw and chaff. Though an invention of vast importance, saving annually millions of dollars in manual labor, and immensely increasing the product of grain throughout the civilized world, the simplicity of the threshing machine and the perfection of Meikle's inventions left little room for great modern improvements. Meikle's, with some modifications, was the first form of drum machine used in the United States; but although the beater drum is still used in Great Britain, it has long been replaced here by the spiked drum, which runs at a higher speed. This form of machine consists principally of a concave bed made of heavy plank lined with iron spikes arranged spirally, into which the drum, also armed with spirally disposed spikes, revolves. Such machines are capable of threshing 300 bushels of oats and over 100 of wheat in 10 hours. Most modern threshing machines have grain separaters attached, by which the grain is winnowed by a revolving fan, and also elevators which are long endless aprons moved on rollers, by means of which the straw is taken up into a mow or on to a stack. Numerous machines of this kind are employed in the United States, es-




Geiser's Threshing Machine.

pecially in the Mississippi and Ohio region. In many places where the farms are not large, it is the practice to employ threshers who move their machines, which are on wheels like those of a wagon, from place to place. One of these machines, patented by Peter Geiser, is represented in the engraving. M is the feeding board, and I the toothed drum, which throws the straw and threshed grain on to an inclined plane between I and B. Between B and C there is a rack, through which the grain falls, while the straw is moved forward on to the elevator N by means of a reciprocating rake. The grain falls back on an inclined plane to E, thence down over the fluted rollers E and F, where, receiving the air blast from the revolving fan H, the chaff is blown away, the grain passing down into receptacles below. Lighter grains and seeds of weeds are blown further, beyond a screen, and are carried along with some good grain by an elevator, back to the thresher at L, by which means all the good grain is saved.

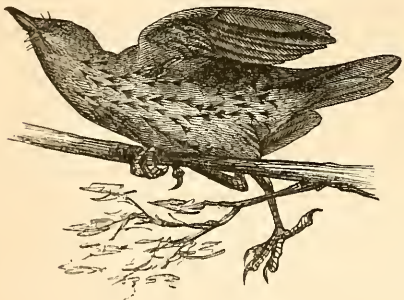
**THROCKMORTON,** a N. W. county of Texas, drained by the Brazos river and its affluents; area, 900 sq. m.; returned as having no population in 1870. The surface is mostly broken and hilly, suited to grazing. In the south, near the Clear fork of the Brazos, is some good farming land.

**THROCMORTON, Sir Nicholas,** an English statesman, born in London about 1513, died there, Feb. 12, 1571. He was page to the duke of Richmond till 1536, was afterward sewer to Henry VIII., and headed a troop at the siege of Boulogne. Distinguished in the Scottish campaign under Somerset, he was knighted, received valuable manors, and sat in parliament as member for Northampton. He was present at the death of Edward VI. in 1553, and, though a Protestant and aware of the movement in favor of Lady Jane Grey, favored the accession of Mary. He was arrested in 1554 as an accomplice in Sir Thomas Wyatt's rebellion, conducted his own defence, and was acquitted, but remanded to the tower on the ground that the verdict was contrary to law. He was released in 1555, lived for a time in France, and in 1556 privately visited the princess Elizabeth at Hatfield, after whose accession he was made successively chief butler of England and chamberlain of the exchequer. As ambassador to France from 1559 to 1563, he favored the policy of Cecil, and intrigued to foment the civil religious war. He was imprisoned in 1569 for favoring a marriage between Mary queen of Scots and the duke of Norfolk, and never regained Elizabeth's confidence.

**THROMBOSIS.** See BRAIN, DISEASES OF THE, vol. iii., p. 198.

**THRUSH,** the common name of a very large family of dentirostral birds, which contains some of the finest songsters in various parts of the world. The bill is of moderate length, rather stout, slightly convex and keeled above, with sharp and notched tip; at the base of the upper mandible on each side of the gape is a row of bristles much smaller than in the fly-catchers; nostrils at the base of bill, partly protected by a membranous scale; wings tolerably long, broad, usually rounded at the end,

with the first quill very small; legs rather short and stout; tarsi compressed, covered in front by a single scale in the typical genus *turdus* (Linn.); tail moderate. The food consists of insects, worms, berries, and fruits, and sometimes mollusks; they move on the ground by hopping on both feet at once.—More than 100 species of the genus *turdus* are described, having the characters given above; they are found in all parts of the world, and are more or less migratory and shy; the nest is made of coarse grasses and mosses, usually lined with mud and soft plants, and is placed on bushes or trees; the eggs are five or six; the flesh is delicate. Several species have been already noticed under Blackbird, Fieldfare, and Robin. Among the American species is the wood thrush (*T. mustelinus*, Gmel.), 8 in. long and 13½ in. in alar extent; the form is stout, the tail nearly even, and the third and fourth quills the longest; the general color is rufous brown above, brightest on the head, and olivaceous on the tail; pure white below, with numerous blackish spots on breast and sides;

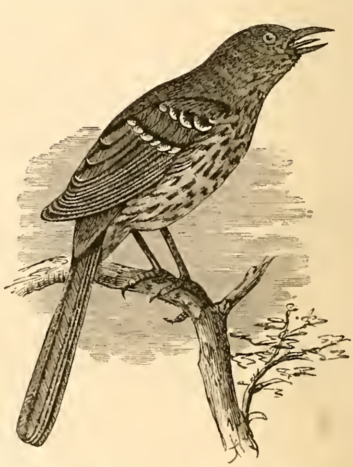


Wood Thrush (Turdus mustelinus).

legs yellow; bill brown, yellowish at base. It is found in the eastern United States to the Missouri river, and south to Guatemala. The notes are few, but powerful, clear, and mellow, rising and falling in gentle cadences; they are especially pleasing at sunset; the food consists of berries and small fruits, and insects; the flight is elevated. The eggs are uniform light blue; the young are easily raised from the egg, and they sing well in captivity. Several other species are described.—Of the European species, the largest is the missel thrush (*T. viscivorus*, Linn.), 11 in. long; it is light grayish brown above, the fore part of the head grayish and the rump shaded with ochrey yellow; secondary coverts and tail feathers tipped with grayish white; a cream-colored band from bill over eyes; below yellowish white, each feather tipped with a black spot, largest and transversely oblong on breast, smaller and triangular on neck. It frequents woods and copses, in small straggling flocks, and is shy and vigilant; it feeds chiefly on berries, especially those of the mistletoe (whence its common name). The song of the male resembles that of the blackbird, and is heard as early as February, before the appearance of the leaves, and even during storms, whence its name of storm cock; it is

Song Thrush or Mavis (Turdus musicus).

very bold in spring. The eggs are four or five, 1¼ by ⅚ in., flesh-colored with irregular scattered spots of brownish red; two broods are generally raised in a season; it has been seen to carry off small birds to its nest to feed its young; the flesh is good. The song thrush, throstle, or mavis (*T. musicus*, Linn.) is 9 in. long, yellowish brown above, tinged with red on the head; secondary coverts tipped with reddish yellow; fore part of neck and breast yellowish, each feather terminated by a triangular brownish black spot; lower wing coverts reddish yellow. It frequents lightly wooded regions and gardens, in the latter destroying snails, which it obtains by breaking the shell against a stone; it is one of the finest of European songsters, singing from early spring to autumn, in the morning and evening, from the



Brown Thrasher (Harporhynchus rufus).

top of a bush or tree. Its flesh, especially in the beginning of winter when the food consists of snails and worms, is very fat and juicy.—

The brown thrush or thrasher is placed by Baird in the subfamily *miminæ* (with the cat bird and mocking bird), and genus *harporhynchus* (Cab.). This bird (*H. rufus*, Cab., or *T. rufus*, Linn.) is 11¼ in. long and 13 in. in alar extent; brownish red above; below pale rufous white, thickly streaked with dark brown, and tinged anteriorly with reddish; two white bands on the wings; inner surface of wings and inner edge of primaries cinnamon; tail rufous. It is found over eastern North America to the Missouri, and to the high central plains; it is a constant resident in the southern states, and is almost as numerous as the robin; it migrates by day, singly, with a low and heavy flight. The song is prolonged, loud, varied, and melodious. The eggs are four to six, dull pale buff, with numerous brown dots; two broods are raised annually in the southern states; it breeds well in aviaries, and the young are raised like mocking birds, singing well and very active in confinement. It is a bold and powerful bird, chasing cats, dogs, and foxes, not afraid of hawks and snakes, and savagely fighting with its rivals in breeding time; both sexes incubate; the food consists of insects, berries, and fruits of all kinds. The water thrush (*seiurus Noveboracensis*, Nutt.; *T. aquaticus*, Wils.) is placed by the most recent ornithologists in the family *sylvicolidæ* or warblers; it is 6¼ in. long and 9¾ in. in alar extent; olive brown above with a green shade; beneath pale sulphur yellow, brightest on the abdomen; the other parts thickly streaked with olivaceous brown, and blackish on the breast. It is found throughout the eastern United States to the Missouri and south to Central America.

**THUANUS.** See Thou, Jacques Auguste de.

**THUCYDIDES,** a Greek historian, born in Athens probably about 471 B. C., died about 400. He was the son of Olorus, and was probably connected with the family of Cimon. He tells us that he owned gold mines in Thrace, opposite Thasos. In 424 B. C. he was the commander of an Athenian squadron of seven ships, and charged with the general authority on the coast of Thrace; but as he failed to arrive in time to prevent the surrender of the important city of Amphipolis to the Spartan general Brasidas, he was condemned to exile, which continued 20 years. He spent much of this time in Thrace; but he must also have visited various parts of Greece, and it is certain from his own writings that he frequently visited the states under Lacedæmonian rule. He returned to Athens about the time the city was freed by Thrasybulus. The accounts of his death are uncertain. According to Pausanias, he was assassinated after his return; according to Plutarch, he was said to have been killed in Thrace, though his remains were carried to his native city. The work by which Thucydides is known is the history of the Peloponnesian war, a work equally distinguished by truthfulness, historical insight, excellence of narration, and masterly arrangement of parts. The first edition was published by Aldus at Venice in 1502. Of the numerous later editions, the best are those of J. Bekker (3 vols., Berlin, 1821), Haack (2 vols. 8vo, Leipsic, 1820), Poppo (10 vols. 8vo, Leipsic, 1821–'38), Arnold (3 vols. 8vo, Oxford, 1830–'35), and Stahl's revised edition of Poppo (Leipsic, 1843–'75). There have been English versions by Nicolls (London, 1550), Hobbes, W. Smith (1753), Bloomfield (1829), Dale (1856), and Richard Crawley (1874).

**THUGS** (Hindi, *thugna*, to deceive), a sect of assassins in India, now exterminated by the British government. They roamed about the country in bands of from 30 to 300, and strangled to death such persons as they could decoy into their company. Their atrocious practices were not followed so much from impulses of plunder or malice as from religious motives. They were worshippers of the goddess Kali, who presided over impure love, sensual indulgence, and death. The members of the sect belonged to different Hindoo castes, and each had its functions. The bands were under a *junadar* or *sirdar*, who was the leader, and a *guru* or teacher. Its members were classified into spies, who were learners; stranglers; entrappers, who were sometimes women; and grave diggers. They usually assumed the dress of merchants or pilgrims, and often craved the protection of those whom they intended to destroy. Their usual instrument of destruction was the handkerchief, with which by a dexterous movement they strangled their victims. The spies having informed the band of the route, habits, and circumstances of their intended victims, the members travelled in such lines as to be near one another, and the entrappers by artful management attracted them to a spot remote from dwellings, where the stranglers executed their office; and having stripped them of whatever they possessed, the grave diggers buried them, with such precautions as generally to prevent discovery. The plunder was divided, one third to the widows and orphans of the sect, one third to the goddess Kali, and the remainder to the partners in the assassination. After a murder the Thugs who had committed it united in a sort of sacrament, eating consecrated sugar. Their deities were carefully consulted before going on their expeditions, and unless the omens were favorable the Thug would not go. Neither women nor old men were victims. Europeans were never killed, as there would have been more danger of detection. There were also bands of Mohammedan Thugs, of the sect of Mooltanees, and it is possible that at first the system of *thuggee* originated with Mohammedan banditti, though it afterward became more a Hindoo than a Mohammedan practice, and the words used are of Sanskrit origin. Thugs were found in all parts of India. Attempts were made to exterminate these bands of murderers in several of the native states, even prior to the present century; but their

connection as a wide-spread religious fraternity remained unknown till 1829, during the administration of Lord William Bentinck, who appointed Capt. (afterward Sir William) Sleeman to break up the organization. This was successfully accomplished by the arrest of every known Thug or relative of a Thug in India; 3,266 such persons were apprehended prior to 1837. They were colonized at Jubbulpore into a trade settlement, where technical instruction was afforded them and their children. Their descendants are still under government supervision there, and the practice of thuggee has become extinct.—In 1836 the government published, for judicial purposes, "Ramaseeana, or a Vocabulary of the peculiar Language used by the Thugs," by Capt. Sleeman. See also "The Confessions of a Thug," by Meadows Taylor (London, 1858).

**THULE,** the name reported by the ancient navigator Pytheas, about the time of Alexander the Great, as that of the northernmost region of Europe. Strabo says that he gives no clue as to whether it is an island, or whether it is inhabited; and it is therefore probable that Pytheas did not visit Thule himself. Iceland is commonly supposed to be the land he referred to, as he says it was six days from the Orcades (Orkney islands); yet there are other reasons which favor the view that Mainland, the largest of the Shetland group, or Jutland, or Norway, is meant.

**THUN. I.** A walled town of Switzerland, in the canton of Bern, on the Aar, about 1 m. from Lake Thun, and 16 m. S. E. of Bern; pop. about 4,700. Among the public buildings are the old Kyburg castle, the cathedral, the federal military academy, and the modern Gothic castle of Schadau. It is a summer resort of tourists to the Bernese Alps. **II.** A lake, 10 m. long, 2 m. wide, and 1,896 ft. above the sea. It connects at the S. E. end with Lake Brienz by the Aar, which again emerges from the N. W. end of Lake Thun, and the water of the Kander is carried into the lake through an artificial channel formed in 1714. The shores near the town of Thun are covered with fine villas and gardens. Near the S. W. shore are the two mountains Niesen and Stockhorn. A small steamer plies regularly.

**THUNBERG, Carl Peter,** a Swedish botanist, born in Jönköping, Nov. 11, 1743, died in Upsal, Aug. 8, 1828. He studied under Linnæus at Upsal, became surgeon in a Dutch ship in 1771, passed three winters at the cape of Good Hope, and between 1773 and 1779 resided principally in Java and Japan. He returned to Sweden in 1779, and was appointed in 1784 professor in the chair formerly occupied by Linnæus, which he retained until his death. His works include *Flora Japonica*, &c. (Leipsic, 1784); a general account of his travels under the title of *Resa uti Europa, Africa, Asia* (4 vols., Upsal, 1788-'91), which was translated into German, English, and French; *Prodromus Plantarum Capensium* (1794–1800); *Icones Plantarum Japonicarum* (1794–1805); *Flora Capensis* (1807–'13); and nearly 100 academical dissertations.

**THUNDER.** See LIGHTNING.

**THURGAU,** a N. E. canton of Switzerland, bounded N. and N. E. by the Rhine and the lake of Constance, separating it from Schaffhausen, Baden, Würtemberg, and Bavaria, S. E. and S. by the canton of St. Gall, and W. by Zürich; area, 382 sq. m.; pop. in 1870, 93,300, nearly all Germans, of whom 23,454 were Roman Catholics. The surface is comparatively level, but numerous hills traverse the country in different directions, the height of which nowhere exceeds 1,000 ft. above the lake of Constance. The principal river is the Thur, which flows N. W. and W. through Thurgau and Zürich to the Rhine. The climate in the southwest is severe, but elsewhere temperate. The soil is not very productive. Fruit is extensively grown, and good wine is produced. About one fifth of the surface is covered with forest. Linen and cotton goods, ribbons, lace, hosiery, and canvas are manufactured. Numerous schools are established throughout the canton. The only language spoken is the German. The executive power is vested in a council (*kleiner Rath*) of seven, who hold office for six years. The grand council or legislature consists of one member for every 220 citizens. It is presided over by two *Landammanns*, chosen annually, and sends five members to the national council. Capital, Frauenfeld.

**THURINGIA** (Ger. *Thüringen*), a central region of Germany, between the Hartz mountains on the north and the Thuringian Forest on the south, the river Saale on the east and the Werra on the west, the principal parts belonging to the Prussian province of Saxony, to Saxe-Coburg-Gotha, Weimar-Eisenach, Schwarzburg-Sondershausen, and Schwarzburg-Rudolstadt. The Thuringians were allies of Attila in the middle of the 5th century. Their country was afterward subdued by the Franks and Saxons. The Franks ruled it for some centuries through dukes and margraves. Under the Saxon emperors several Thuringian counts or landgraves obtained a kind of semi-independence. Louis the Jumper, son of Louis the Bearded, warred against the emperor Henry IV. in the latter part of the 11th century, and several of his successors added to the possessions of the house. One of them, Hermann (1190–1216), is chiefly known as a patron of minnesingers. A long war of Thuringian succession was waged about the middle of the 13th century, the termination of which left the principal parts of the country in the possession of the margrave Henry of Meissen. Thuringia was now ruled by the Saxon house of Wettin, until, after various changes, the Saxon dominions were divided in 1485 between Ernest and Albert, the sons of Frederick the Mild, when Thuringia fell to the Ernestine line. (See SAXONY.)—The Thuringian Forest (Ger. *Thüringerwald*), which bounds

it S. W. and S., is a narrow and wooded mountain range, rising in some parts upward of 3,000 ft., and extending nearly 70 m., not including numerous northern offshoots toward the Hartz. In the southeast it approaches the Fichtelgebirge, and in the southwest the Rhön, from which it is separated by the valley of the Upper Werra. The inhabitants are chiefly engaged in mining, grazing, and manufactures. The territory covered or traversed by the Thuringian Forest is included in the Prussian province of Saxony, Saxe-Weimar-Eisenach, Meiningen-Hildburghausen, Saxe-Coburg-Gotha, Schwarzburg-Rudolstadt, Altenburg, and the Reuss principalities, all of which territories are called Thuringian in the wider sense.

**THURLOE, John,** an English statesman, born at Abbots Roding, Essex, in 1616, died in London, Feb. 21, 1668. He was called to the bar in 1647, and in 1652 became secretary to the council of state, and in 1653 secretary to the protector. In 1657 he was made a privy councillor, and in 1658 governor of the Charterhouse and chancellor of Glasgow university. While continuing to hold office under Richard Cromwell he was accused of offering his services to promote the restoration of Charles II., and was imprisoned in May and June, 1660. After his release he took no part in public affairs. His collection of state papers, with a number of private papers and letters, was edited, with a life of Thurloe, by Thomas Birch, D. D. (7 vols. fol., London, 1742.)

**THURLOW, Edward,** lord, an English statesman, born at Little Ashfield, near Stowmarket, Suffolk, in 1732, died in Brighton, Sept. 12, 1806. He was educated at Cambridge, was called to the bar in 1754, entered upon a lucrative practice, and was appointed king's counsel in 1761. In 1768 he was elected to parliament, in 1770 was appointed solicitor general, in 1771 attorney general, and in 1778, as a reward for his zealous advocacy of the government policy respecting America, he was made lord chancellor in Lord North's ministry, and raised to the peerage as Baron Thurlow. By command of the king he retained the office of lord chancellor in the Rockingham and Shelburne administrations, notwithstanding he was politically opposed to his coadjutors, and lost no opportunity to defeat their leading measures. This led to the withdrawal of Fox; and in the coalition ministry which succeeded, it was stipulated that Thurlow should not hold a seat. He still remained in confidential relations with the king, and on the accession of Pitt to power, in December, 1783, received again the great seal, which he held for more than eight years. He opposed certain measures of the cabinet, which led to his removal at the request of Pitt, whom he always disliked, and with the consent of the king. He was overbearing and passionate, a dictator rather than a debater in parliament, but an impressive and eloquent speaker.—His nephew and heir, EDWARD HOVELL-THURLOW, second lord (1781–1829), published "Ariadne, a Poem in three Parts" (1814), "Carmen Britannicum" (1814), and several volumes of miscellaneous poems, including translations from Anacreon and Horace.

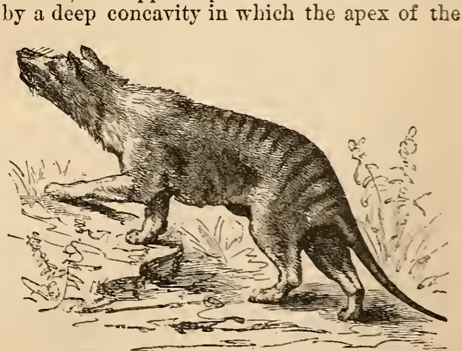
**THURN AND TAXIS.** See POST, vol. xiii., p. 748.

**THURSDAY,** the fifth day of the week, the *dies Jovis* of the Roman calendar, and sacred in the northern mythology to the thunderer Thor, from whom it is named. In German it is called *Donnerstag* (thunder day, originally Thunderer's day).

**THURSTON,** a S. W. county of Washington territory, bounded N. E. by the Nisqually river, and W. by the Coast range; area, 672 sq. m.; pop. in 1870, 2,246. Much of the surface is mountainous, but there are several rich valleys. An arm of Puget sound extends into the N. E. part, and it is drained by the Des Chutes river and other streams. The Pacific division of the Northern Pacific railroad passes through it. The chief productions in 1870 were 10,602 bushels of wheat, 1,778 of rye, 17,515 of oats, 18,375 of potatoes, 16,511 lbs. of wool, 40,425 of butter, and 3,013 tons of hay. There were 788 horses, 1,134 milch cows, 1,973 other cattle, 4,192 sheep, and 788 swine; 2 flour mills, 1 tannery, 1 currying establishment, and 3 saw mills. Capital, Olympia, which is also the capital of the territory.

**THYESTES.** See ATREUS.

**THYLACINE,** or **Pouched Wolf,** a marsupial animal of the dasyurine family, and genus *thylacinus* (Temminck) or *peracyon* (Gray), peculiar to Tasmania; both of the generic names indicate the possession of the pouch. In this genus the dentition is: incisors $\frac{8}{6}$, the outer slightly the largest; canines $\frac{1-1}{1-1}$, large, simply conical, the upper separated from the incisors by a deep concavity in which the apex of the



Dog-headed Thylacine (Thylacinus Harrissii).

lower is received when the jaws are closed, in this differing from carnivora proper, in which the lower canines pass outside of the upper jaw; premolars $\frac{3-3}{3-3}$, separated from each other; molars $\frac{4-4}{4-4}$, with a large central cusp, and two smaller, one in front and the other behind it. The humerus has the inner condyle perforated, the hind feet have no in-

ner toe, and the marsupial bones are absent, represented only by fibro-cartilage; the female has a distinct pouch, with four mammæ. Only one species is described, the dog-headed thylacine (*T.* [*P.*] *Harrissii*, Temm.), about the size of a young wolf, or 3⅝ ft. long, with a tail 20 in. additional, and a height at the shoulders of about 22 in.; the head is dog-shaped, with narrow and elongated muzzle; ears short, pointed, very broad at the base, and well covered with hair on both surfaces; eyes full and black, with a nictitating membrane; long black bristles on the upper lip, and a few on the cheeks and above the eyes; the claws stout, short, and brown, the bottoms of the feet with large, very rough pads. The fur is short and close, waved and slightly woolly; the general color is grayish brown, paler below, with 12 to 14 transverse black bands on the back, longest and widest posteriorly; pale around eyes, and edge of upper lip white; tail with short fur, with longer hairs at under side of apex; rusty red about the pouch; the legs are shorter in proportion than in the wolf, and the gait is semi-plantigrade. It is wild and shy, inhabiting the caverns and dismal glens of mountainous districts; inactive during the daytime, probably from imperfect vision, it preys at night upon the smaller marsupials; it is sometimes so large as to be a match for several dogs, and is one of the most formidable of Australasian quadrupeds; it is rare except in the most inaccessible regions. Among the fossil remains of the caves of Wellington valley, New South Wales, Prof. Owen has described parts of lower jaws of what he calls *T. spelæus*, differing from existing ones in their greater depth. In the secondary schists of Stonesfield has been discovered the genus *thylacotherium* (Owen), known by the lower jaw, which has six incisors, two moderate canines, six false and six true tricuspid molars; the *T. Prevostii* (Cuv.) was about the size of a rat. An allied genus from the same strata is *phascalotherium* (Broderip), somewhat larger.

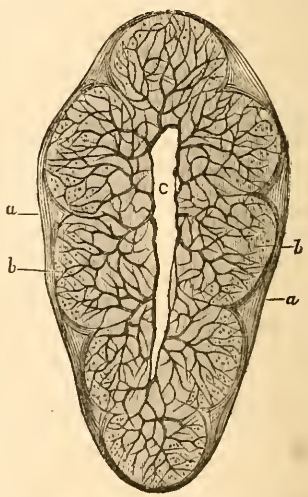
**THYME,** low undershrubs or perennial herbs, of the genus *thymus* (Gr. θύμος, from θύειν, to burn perfume, it having been used as incense), of the labiate or mint family. The wild or creeping thyme of northern Europe (*T. serpyllum*) is sparingly naturalized in the older states in old fields, and in some cases as a weed upon lawns; it is much branched and prostrate, forming low dense tufts a foot in diameter; its very small ovate leaves are fringed at the base with a few long hairs, and its purplish flowers are crowded in whorls at the ends of the branches. This is sometimes cultivated as an aromatic herb, but not so much so as the garden thyme (*T. vulgaris*), from southern Europe, which differs from the preceding in having a more erect and bushy habit, paler leaves, and flowers in shorter clusters; there are varieties of this, both the broad-leaved and narrow-leaved being known in kitchen gardens, and the variegated or golden thyme, which has each leaf distinctly marked with yellow, is a pleasing ornamental plant. Lemon thyme,

Wild Thyme (Thymus serpyllum).

much esteemed by some for its peculiar flavor, is *T. citriodorus.* The thyme in general use is *T. vulgaris*, the foliage of which is highly aromatic and much used for flavoring in cookery; its properties are due to an essential oil, the oil of thyme, which is used as an external stimulant, in liniments, especially in veterinary medicine; it contains a liquid and a solid oil or camphor, separable by fractional distillation.

**THYMOL.** See p. 909.

**THYMUS GLAND** (Gr. θύμος), a double vascular or ductless gland, situated, in the human subject, in the upper part of the anterior medias-




Transverse Section of an injected Lobule of the Thymus of a Child, magnified 30 diameters. *a.* Membrane of the lobule. *b.* Membrane of the gland follicles. *c.* Cavity of the lobule from which the larger vessels branch out into the corpuscles, on the surface of which they terminate, occasionally forming loops.

tinum, extending in childhood from the thyroid gland to the anterior surface of the pericardium, but becoming atrophied after the age of puberty. It is divided into two lateral portions, right and left, which are in reality distinct from each other, being connected only by areolar tissue. Each lateral portion is gland-like in structure, being divided into a number of lobules, from a sixth to a third of an inch in diameter, and irregularly rounded and flattened. In its interior is a central cavity, having the form in some cases, according to Kölliker, of a cylindrical canal, communicating with that of the separate lobules, and containing a grayish white or milky-looking fluid, of a slightly acid reaction. Each lobule is invested on its exterior by a thin, nearly homogeneous membrane, which sends partitions a short distance into its substance, dividing it in this way externally into rounded masses or gland follicles, each about $\frac{1}{50}$ of an inch in diameter, giving the outer surface of the lobule a granular appearance. The solid substance of the lobule consists of a soft homogeneous material, containing nucleated cells and an abundance of free nuclei, and penetrated throughout by capillary blood vessels, which radiate from the wall of the central cavity and terminate in vascular loops toward its external portion. Its central cavity has no excretory duct, and its secreted product, if such there be, must be taken up and carried away by the veins or the lymphatics. The thymus gland is highly developed during the latter part of intra-uterine life, and at the time of birth, in man, weighs rather more than half an ounce. It continues to enlarge until the age of two years, at which time its growth ceases. It begins to diminish about the 10th year, but is still usually perceptible, and sometimes well developed, at the age of 20. By the 40th year it has entirely disappeared. It is about the same in the anthropoid apes as in man, and is remarkably developed and may be well studied in the calf, in which, and in the lamb, it is called the sweetbread, and is a delicate article of food; it exists in mammals, birds, and most reptiles, but not in the larvæ of batrachians, the perennibranchiate amphibians, or fishes.—The precise function of the thymus gland is unknown. It undoubtedly serves, like the other ductless glands, to accomplish some change in the blood circulating through its tissue, which is essential to the proper nourishment of the body during intra-uterine life, infancy, and childhood.

**THYROID GLAND** (Gr. θυρεός, a shield, and εἶδος, form), one of the vascular or ductless glands, situated on the anterior and lower part of the larynx, in front of the upper rings of the trachea; so called from its being situated in front of the thyroid or shield-like cartilage of the larynx. It is composed of two elongated ovoid lobes, flattened from before backward, united or separate, but generally connected by a transverse portion; it is covered by the muscles of the front of the neck. The tissue is tolerably firm, brownish and yellowish red, formed of lobes and lobules, consisting essentially of an aggregation of closed gland follicles imbedded in condensed areolar tissue; these contain a small amount of a fatty albuminous fluid, and do not communicate with any common reservoir; among the follicles are nucleated corpuscles or epithelial cells; it receives four arteries from the subclavians and the carotids, nerves from the pneumogastric and the sympathetic, and lymphatics communicating with the glands of the neck. The vascular supply is great, and forms a very minute capillary plexus on the membrane of the follicles; like other ductless glands (see THYMUS GLAND), it is relatively larger in intra-uterine existence and in infancy than in after life. Its products are probably discharged into the venous blood, and serve for the elaboration of the circulating fluid. It is usually larger in females than in males; it is found in all mammals, birds, and reptiles, probably in the batrachians, and perhaps also in fishes. The organ may be inflamed, with suppuration, and variously enlarged. In the adult it is sometimes abnormally enlarged, forming the disease known as goitre or bronchocele, which is itself often an accompaniment of cretinism. (See GOITRE.)

**TIAGUANACO,** or **Tiahuanaco.** See TITICACA.

**TIARA** (Gr.), a species of high hat anciently worn by many eastern nations. Those of kings and priests were encircled by a sort of crown, whence the term tiara has been applied to the triple crown worn by the popes, which in turn

FIG. 1.—Persian Tiara.

FIG. 2.—Assyrian Tiara.

bears a striking resemblance to the Persian royal tiaras and to those of the Assyrian kings, represented on the slabs at Nineveh. It is uncertain when the popes assumed the tiara. It was called *regnum*, or emblem of royalty, to distinguish it from the mitre. Pope Innocent III., in his sermon on St. Sylvester, says that the bishop of Rome uses the mitre everywhere and at all times, because his episcopal jurisdiction is universal, whereas he only uses the *regnum* or tiara occasionally and in his own dominions. The papal tiara was at first a conical cap, topped with a small round ball, and wreathed about the forehead with a crown of gold. It retained this shape

FIG. 3.—Tiara of the Pope.

till Boniface VIII. (1294–1303) added to it a second crown, and Urban V. (1362–'70) added a third. It kept to its first sharply pointed form till the beginning of the 16th century, when it assumed an oval shape, swelling out somewhat broad at top.

**TIBALDI, Pellegrino**, otherwise called Pellegrino Pellegrini, an Italian artist, born in Bologna in 1527, died in Milan about 1598. At 20 years of age he visited Rome, where he studied the works of Michel Angelo, and was employed by Cardinal Poggio to decorate his palace in Bologna. In 1586 he was invited by Philip II. to Spain, and during a residence there of nine years executed frescoes in the Escurial, besides many pictures. He was also an architect; his best architectural designs were the modern façade attached to the cathedral of Milan, and the Casa Professa, or house of the Jesuits, in Genoa.

**TIBBOOS.** See Tuariks.

**TIBER** (It. *Tevere;* anc. *Tiberis*), a river of Italy, rising in the Tuscan Apennines, 5 m. N. of Pieve San Stefano, and thence flowing generally S. S. E. and S. S. W., through the provinces of Arezzo and Perugia and between the latter and Viterbo, to Fiano, where it turns S. W., and passing through the province and city of Rome discharges into the Mediterranean near Ostia by two mouths, which enclose the Insula Sacra of the ancients. Its length is about 230 m., and its width at Rome and below from 300 to 500 ft. Its principal affluents are the Chiascio, the Nera (anc. *Nar*), and the Teverone (*Anio*) from the left, and the Paglia from the right. In the upper part of its course, between Todi and the Passo del Forello, it is obstructed by rapids and passes for some miles through a narrow gorge. It is navigable for vessels of 130 to 200 tons to Rome, 18 m. from its mouth, and for boats to the confluence of the Nera, about 90 m. Rome and Perugia are the principal cities in its basin. From Perugia, above its confluence with the Chiascio, to its debouchure, its waters have a yellowish tinge, the result of the yellow clay through which it passes. An appropriation was granted at the end of 1875 by the Italian government for the preliminary measures relating to the improvement of the course of the Tiber. Various plans are proposed for that purpose, including one of vast scope advocated by Garibaldi.

**TIBERIAS.** See Gennesaret.

**TIBERIUS**, an emperor of Rome, born Nov. 16, 42 B. C., died March 16, A. D. 37. His full name was Tiberius Claudius Nero Cæsar. He was the eldest son of Claudius Tiberius Nero and Livia Drusilla. His father divorced his wife in order that she might be married to Augustus; and when he died, in 33 B. C., his funeral oration was pronounced before the rostra by his son, then only nine years old. Tiberius was educated by the emperor with princely care. In 29 he accompanied Augustus in his triumphal entry into Rome, and subsequently married Vipsania Agrippina, by whom he had a son named Drusus; but in 11 he was compelled by the policy of Augustus to divorce her, much against his will, and marry the beautiful but dissolute Julia, daughter of the emperor. In spite of her licentiousness he seems to have lived peaceably with her for a year, and had by her one child which did not live; and after that event the feelings of dislike between them gradually increased until they led to a virtual separation. As military tribune Tiberius made his first campaign in the Cantabrian war. In 20 he went to Asia Minor, restored Tigranes to the throne of Armenia, and compelled the Parthians to give up the eagles taken from Crassus; in 15 he and his brother Drusus carried on a war against the Alpine nations of Rhætia, and the exploits of the two were celebrated by Horace. In 13 Tiberius became consul with P. Quintilius Varus; in 11 conducted the war against the revolted Dalmatians and the Pannonians; and in 9, when Drusus was fatally injured in Germany, he hastened from Pavia to the place where his brother was dying, and after his death conveyed the body to Rome, walking all the way before it on foot, and on arriving in that city pronounced over it a funeral oration in the forum. He returned to Germany, gained several victories, and crossed the Rhine; but in 7 he went back to Rome, celebrated his second triumph, and was made consul a second time. In 6 he obtained tribunitian power for five years, but suddenly formed the resolution of retiring to Rhodes. According to Tacitus, this was to get away from the licentiousness of his wife; but other authorities say it was on account of the jealousy between himself and the grandsons of Augustus. At Rhodes he resided eight years, living in a very simple style. While he was absent his wife was banished (2 B. C.) to the island of Pandataria, and at the expiration of his tribunitian power Tiberius asked leave to return to Rome; but permission was not granted till A. D. 2, and then only on condition that he would take no part in public affairs. The death of the two older grandsons of Augustus virtually left Tiberius the succession to the throne, and in A. D. 4 he was adopted by Augustus. From this time to the death of the emperor he was constantly employed in military operations. He conquered all Illyricum, gained great victories over the Germans and the Dalmatians, and in 12 celebrated his fourth triumph. His military successes were all-important, as the loss of Varus and his legions in Germany had placed the empire in danger. In 14 he started for Illyricum to conduct the war in that quarter, when he was recalled by the death of Augustus to ascend the throne. One of the first acts of his reign was to put to death Agrippa Postumus, the only surviving grandson of Augustus, alleging that the execution was in accordance with the wishes of the late emperor. The first years of his

reign were marked by prudence and moderation. He rejected all flattery from the senate, placed in office the most worthy persons, and made efforts to relieve the scarcity of bread constantly recurring in Rome. Meanwhile a mutiny of the legions in Pannonia was only quelled by the energy of Drusus, the emperor's son, and the terror inspired by a solar eclipse. Under the influence of Sejanus, who had become his favorite, the natural severity of his temper began soon to degenerate into cruelty. The election of magistrates was taken from the popular assembly and transferred to the senate, which sat simply to register the decrees of the emperor. The charges of *læsa majestas*, by which all persons suspected of impugning by word or deed the majesty of the emperor were tried, were prosecuted with great rigor. A secret organization of *delatores*, or spies, was formed, and their infernal machinations exposed the life, the fortune, and the honor of every Roman citizen to hourly danger. After the death of Germanicus (see GERMANICUS) the emperor surrendered himself more and more to the influence of Sejanus. By his advice the prætorian cohorts, stationed hitherto in various parts of the city, were assembled in one camp, in the vicinity of Rome. At the same time the power of the empire was thoroughly maintained in the provinces, and two revolts in 21, one on the Moselle headed by Julius Florus, and the other among the Ædui headed by Julius Sacrovir, were put down and their leaders forced to slay themselves to escape from the imperial troops. In 23 Sejanus caused the death of Drusus by poison. Whether Tiberius felt any sorrow or not, he certainly manifested none; and when the people of Troas sent him a message of condolence, he sneeringly sent back an answer of condolence on the death of their fellow citizen Hector. In 26 the emperor finally departed from Rome. He first went to Campania, and there issued an edict commanding the people not to molest his retirement, and in the following year went to the island of Capreæ (Capri). The early part of his reign had been marked by a strict regard for external decency, and a stringent law had been passed against courtesans; but his last years were spent in the most infamous pleasures. Capreæ became the haunt of disgusting debauchery, especially after the death of Livia Drusilla in 29, who had always exercised much influence over her son. In 30 he banished Agrippina, the widow of Germanicus, and afterward caused the assassination of two of her sons. Henceforth Sejanus had the full control of affairs of state. The employment of *delatores* gave him abundant means of getting rid of obnoxious individuals on false charges. Tiberius, who had been suspecting for some time the plots of his minister, managed to get rid of Sejanus in 31, and the favorite and all his family were destroyed. In the mean time the emperor became, in the words of Pliny, "the most wretched of men." In the remarkable letter sent to the senate, which Tacitus has preserved, he begins with a frank avowal of his misery. "What to write to you," he says, "or how to write, I know not; and what not to write at this time, may all the gods and goddesses torment me more than I daily feel that I am suffering, if I do know." About this time he went once more to Campania, and occasionally came as near Rome as his gardens on the Vatican. But his privacy was never disturbed; soldiers were placed so as to prevent any one from coming near him. He had been remarkable for beauty and majesty of person, but dissipation had covered his face with ugly blotches, and his body was bent nearly double. At Astura he was attacked by illness, and he reached Misenum to die in the villa of Lucullus. According to Tacitus, it was left to fate to determine his successor. On March 16 he had a fainting fit, and as he was thought dead, Caius Caligula, the son of Germanicus, was saluted as his successor; but the emperor suddenly recovering, a quantity of clothes was thrown over him and he was left alone. There is another account of his death. The people hailed the event with delight, and the cry of "Tiberius to the Tiber" was heard constantly in the streets of Rome. He however had a public burial. The chief authorities for his life are Suetonius, Dion Cassius, and above all Tacitus. He wrote a commentary of his own life, Greek poems, an ode on the death of L. Cæsar, and several epistles and orations, either to the senate or on occasion of funerals. The crucifixion of Christ took place during his reign.—See *Tiberius' Leben, Regierung und Charakter*, by Adolf Stahr (Berlin, 1874).

**TIBET.** See THIBET.

**TIBULLUS, Albius**, a Roman poet, of the time of Augustus. He was of an equestrian family, and lived on his ancestral estate at Pedum near Rome. He went to Aquitania in 31 B. C. with his patron Messala, and when the latter had pacified that part of Gaul and set out to take command in the East, Tibullus accompanied him, but falling sick returned to Rome, and died young. Four books of elegies are attributed to him, but only the first two are undoubtedly his. Tibullus was a warm friend of Horace, who addressed two poems to him. The first edition of his works was printed, along with Catullus, Propertius, and the *Silvæ* of Statius, at Venice in 1472. Two of the best late editions are those of Rossbach (Leipsic, 1866) and Müller (Leipsic, 1873). The elegies of Tibullus have been translated into English verse by Dr. Grainger (1752), and a prose translation forms a volume of Bohn's "Classical Library" (London, 1854).—See Seiler, *De Tibulli Elegia* (Halle, 1872).

**TIBUR.** See TIVOLI.

**TIC DOULOUREUX.** See NEURALGIA.

**TICHBORNE TRIAL**, the most celebrated conspiracy case, and the first in which the impos-

tor assumed identity with a known person, in English legal records. Roger Charles Tichborne, born Jan. 5, 1829, was, after his father, heir to the title and great estates of his uncle, Sir Edward, who added the name Doughty to Tichborne. After an education in France and at the Roman Catholic college of Stonyhurst, Roger entered the army in 1849. In 1852 he offered himself to his cousin Kate, daughter of Sir Edward; but her parents opposed the marriage, upon which he resigned his commission and went to sea. He arrived at Valparaiso June 19, 1853, and on April 20, 1854, sailed from Rio de Janeiro for New York in the ship Bella, which was lost at sea. Sir Edward died March 5, 1853, and was succeeded by his brother James, Roger's father, who died June 11, 1862. In the presumed loss at sea of Roger, he was succeeded by his second son Alfred, who died Feb. 22, 1866, and was succeeded by a posthumous son, born May 28, 1866. In 1865 Lady Tichborne, widow of Sir James, began to advertise in English and Australian newspapers for her son Roger, whom she believed to be alive. In 1866 a butcher in Wagga Wagga, Australia, supposed to be Arthur Orton, but then calling himself Thomas Castro, asserted that he was Roger Charles Tichborne, and had been saved from the wreck of the Bella. After some correspondence with Lady Tichborne, he sailed for London, arrived there Dec. 25, and in January, 1867, went to Paris, where Lady Tichborne accepted him as her son and supplied him with money. Nearly every other member of the family repudiated him as an impostor; but he found many adherents who assumed to recognize him as the long lost Roger, and went about England collecting witnesses and gathering information concerning the family, the estates, and incidents in Roger's life. In March, 1867, he filed a bill in chancery to restrain the trustees of the estates from setting up certain outstanding terms as an answer to any action he might bring to recover the property. The commencement of the action was delayed nearly four years by the sending of commissions to South America and Australia, and by other causes. In the mean time Lady Tichborne died, March 12, 1868. The case had excited extraordinary attention. Public opinion was divided, though so many believed in the claimant that he was able to raise considerable money by the sale of bonds payable upon his coming into possession of the property. On May 11, 1871, the trial for the recovery of the Tichborne estates in Hampshire and Dorsetshire, valued at £24,000 a year, was begun in the court of common pleas. With two adjournments, it continued 103 days, till March 6, 1872, when the jury interposed, declaring themselves satisfied that the claimant was not Roger Charles Tichborne, and he was nonsuited. He was immediately ordered into custody to be tried for perjury, but was subsequently released on bail. The trial for perjury of Thomas Castro, otherwise Arthur Orton (as the indictment ran), was commenced in the court of queen's bench on April 23, 1873, and continued 188 days to Feb. 28, 1874, when he was found guilty and was sentenced to 14 years' penal servitude. He was sent to Millbank, and subsequently transferred to Dartmoor prison. The principal points in the two cases which led to the claimant's conviction were these: After assuming to be Tichborne, the claimant, though hard pushed for money, did not avail himself of balances and credits which Roger had with two Australian bankers. On arriving in London he immediately sought for the relatives of Arthur Orton, and subsequently sent to one of the Orton sisters photographs of himself, wife, and child as those of Arthur Orton and family. He was entirely ignorant of incidents connected with Roger's residence in France, and knew no French, which Roger spoke better than he did English. The handwritings of the two were wholly unlike. Roger was well educated, while the claimant was grossly illiterate. The physical differences between the two were even more marked. Roger was thin; his hair was straight; his ears adhered to the sides of his head. The claimant was enormously fat; he was an inch taller than Roger; his head was larger; his hair was inclined to curl; his ears were dependent and free, with large lobes; and it was clearly proved that one of Roger's arms was tattooed with his initials, while no such marks could be found on the claimant. The career of the claimant was also closely traced from the time when he left England to the time when he assumed to be Roger. The expense of the trials compelled the trustees to mortgage the Tichborne estates.—See "Charge of the Lord Chief Justice in the Case of The Queen *v.* Castro" (2 vols. 8vo, London, 1875).

**TICINO** (Fr. and Ger. *Tessin*), a S. canton of Switzerland bordering on Valais, Uri, Grisons, and Italy; area, 1,095 sq. m.; pop. in 1870, 119,619, nearly all Roman Catholics. The surface is mountainous, but the N. part is more elevated than the S., that frontier being formed by lofty summits of the Alps, including the central mass of the St. Gothard range; and a considerable portion of it belongs to the glacier region. The face of the country has a general slope toward the south, and lofty mountain ridges traverse it in that and a S. E. direction. With the exception of a small part of the north, the drainage belongs to the basin of the Po. The principal river is the Ticino (anc. *Ticinus*), which, rising in Mt. St. Gothard and receiving numerous tributaries, flows through Lago Maggiore, a small portion of which is within the boundary of the canton, to the Po near Pavia. There are several other lakes, including Lugano, Muzzano, and Origlio. In the elevated parts of the canton the chief business is cattle rearing and butter and cheese making. In the south there are on the lower slopes chestnut forests, and in the valleys vineyards, corn fields, and plantations of figs, almonds, oranges, citrons,

mulberries, and pomegranates. Game is abundant in the forests, and the streams and lakes are well stocked with fish. The manufactures are of no importance. The inhabitants belong to the Italian race, and speak that language. Only one village, Bosco, situated near the frontier of Valais, speaks German.—Ticino was conquered from Italy by the Swiss in 1512, and, under the name of the Italian bailiwicks, was governed by deputies till 1803, when it was admitted as a member of the Swiss confederation. The government is vested in a council chosen by all citizens who have attained the age of 20 years. The property qualification of voters was abolished in 1863. The grand council meets alternately at Lugano, Locarno, and Bellinzona. The canton sends six members to the national council. The railway from Bellinzona to Locarno was opened Dec. 20, 1874.

**TICK,** the common name of several families of small arachnids infesting the skin of man and the lower animals. In addition to what has been given under Epizoa and Mite, it may be stated that, from the young tick having only three pairs of legs instead of the four pairs of the adult spider and mites, some have maintained that the arachnids form an order of the class of insects, and not an independent class. The legs also in the young are very long and the head separate from the thorax, as in the insect. (See "American Naturalist," vol. iii., 1869, pp. 364-373.)

**TICKELL, Thomas,** an English poet, born at Bridekirk, Cumberland, in 1686, died in Bath, April 23, 1740. He was educated at Queen's college, Oxford, and in 1710 was chosen fellow. He was a friend of Addison. During the negotiations for peace with France, Tickell published a poem entitled "The Prospect of Peace," which went through several editions. On the arrival of King George I. he wrote "The Royal Progress," printed in the "Spectator." His translation of the first book of the Iliad was brought out in opposition to that of Pope. Addison declared it the best version ever made, and it was suspected that he himself was the translator. Besides some minor poems, Tickell published a "Letter to Avignon," written during the dispute on the Hanoverian succession, and an elegy on Addison, which was extravagantly praised by Johnson. Addison had employed Tickell in public affairs, and when in 1717 he was appointed secretary of state, he made him his under secretary. In 1725 Tickell became secretary to the lords justices of Ireland, in which office he died.

**TICKNOR, George,** an American author, born in Boston, Aug. 1, 1791, died there, Jan. 26, 1871. He graduated at Dartmouth college in 1807, studied law, and was admitted to the Boston bar in 1813, but never practised. From 1815 to 1820 he resided in Europe, and on his return became professor of the French and Spanish languages, literature, and belles-lettres in Harvard college. He resigned in 1835, and spent three years in Europe. In 1849 appeared his "History of Spanish Literature" (3 vols. 8vo, New York; 4th ed., edited by G. S. Hillard, 3 vols., Boston, 1871), which was translated into Spanish, German, and French (in part), and was accepted as an authority in Spain itself. Mr. Ticknor was one of the association of writers by whom the "Monthly Anthology" was conducted. His latest publication was the life of his friend W. H. Prescott (Boston, 1864).—See "Life of George Ticknor," by George S. Hillard (Boston, 1876).

**TICONDEROGA,** a town of Essex co., New York, enclosing the outlet of Lake George, 88 m. N. by E. of Albany; pop. in 1870, 2,590; in 1875, 3,401. It is at the junction of the Addison railroad, a branch of the Central Vermont, with the Champlain division of the Delaware and Hudson canal company's lines, and is the S. terminus of the Lake Champlain company's steamers. The portion of the town lying between Lakes George and Champlain is a lofty promontory, the terminus of a mountain ridge; Mt. Defiance at the extremity of the promontory is 750 ft. above the surface of Lake Champlain. The outlet of Lake George, 4 m. in length, has a fall in 2 m. of 220 ft.; and as the water never apparently varies in quantity, and is remarkably pure, it forms a very valuable water power. There is a vein of excellent graphite in the town, and about 25 tons of black lead are produced monthly by the "American Graphite Company," the only one in the United States. There are also extensive deposits of good iron ore, which is mined by the "Iron Company." Large quantities of lumber are manufactured, and there are an extensive sash and door factory, two founderies, two woollen mills, and a cotton factory of 20,000 spindles. The town has 15 schools, a weekly newspaper, and Baptist, Congregational, Episcopal, Methodist, and Roman Catholic churches. Nearly the entire business portion was destroyed by fire, March 31, 1875; it is now being rebuilt with fine brick blocks.—The town is particularly remarkable for the prominent place its fortifications have held in American history. Early in 1755 the French, who had already occupied and fortified Crown Point, and caused a careful survey of Lake Champlain to be made, advanced to Ticonderoga and commenced a fortification there, which entirely commanded the passage of the lake. This fort they named Carillon (chime of bells), in allusion to the music of the waterfalls near it. It was afterward known as Fort Ticonderoga. Sir William Johnson was the commander of an English and colonial army the same year intended for the reduction of this fortress and Crown Point; but learning that the French had reenforced it largely, he contented himself, after defeating Dieskau at Lake George, with fortifying Fort William Henry at the S. end of that lake. In 1757 Montcalm assembled a force of 9,000 men at Fort Carillon, and ascending Lake George attacked and reduced Fort Wil-

liam Henry, Aug. 3. In the summer of 1758 Gen. Abercrombie took the command of an expedition for the reduction of Fort Carillon, crossed Lake George with 15,000 men, and on July 8 attempted to take the fort by storm, but was repulsed with a loss of 2,000 men. In 1759 Gen. Amherst at the head of 12,000 men invested Ticonderoga, and the French, not having a sufficient force to hold it, dismantled and abandoned it, July 30; and soon after Crown Point was also abandoned. The English government then greatly enlarged and strengthened the two fortresses. The fort and field works of Ticonderoga extended over an area of several miles. After the cession of Canada in 1763, the fort was allowed to fall into partial decay, and was held by a small force. Upon the receipt of the news of the battle of Lexington, Col. Ethan Allen surprised the fort, May 10, 1775, and captured the garrison of 50 men and the artillery and munitions of war in the fort. (See Allen, Ethan.) The centennial of this event was celebrated in the town on May 10, 1875. In 1776, after an engagement between the British and Americans, the latter were compelled to take refuge under the guns of Fort Ticonderoga. On June 30, 1777, Burgoyne invested the fort, and on July 4 erected a battery on Sugarloaf hill (now Mt. Defiance), which completely commanded it and compelled the garrison to evacuate it the next night, sending their stores and munitions to Skenesborough (now Whitehall), and escaping themselves into Vermont. In September of the same year Gen. Lincoln made an attack upon the works, took Mts. Hope and Defiance, released 100 American prisoners, and took 293 of the enemy, an armed sloop, several gun boats, and more than 200 bateaux, but did not capture the fort. After the surrender of Burgoyne the fort was dismantled, and the garrison retreated down Lake Champlain; some of them were captured by Capt. Ebenezer Allen. In 1780 Gen. Haldeman with a company of British soldiers occupied Ticonderoga some time; and from this point Major Carleton made a diversion against Forts Anne and George, to aid Sir John Johnson. After the war the fort fell into ruins; portions of the walls are still standing.—There is a history of Ticonderoga by the Rev. Joseph Cook (Keeseville, N. Y., 1858).

**TIDEMAND, Adolph.** See p. 909.

**TIDES**, the alternate rising and falling of the waters of the ocean, which is to be observed on all its coasts and estuaries. The rising is designated as the flood, and the highest elevation as high water; the falling is called the ebb, and the lowest depression low water. The duration of high and low water without apparent change of level is known as the stand, and the cessation of the ebb and flood streams or tidal currents is called slack water. The tides of each day occur somewhat later than those of the preceding day, the average retardation from day to day being about 50 minutes. The times of occurrence of high water bear a very close relation to the appearance of the moon in certain positions. Thus at New York high water occurs when the moon is about E. S. E.; at New Castle, on Delaware river, when the moon is nearly S.; at Baltimore when it is rising or setting. These are rude statements, but they are sufficiently accurate for many purposes, and they show at once the close connection between the time of high water and the time of the moon's passage over the meridian. In fact, so completely is this recognized, that, in order to give the time of high water upon any day, it is usually thought sufficient to state the time of high water on the days of new moon and full moon (or "full and change") when the moon passes the meridian at 12 o'clock nearly. This time is called the establishment of the port. Then to find (roughly) the time of high water on any other day, it is only necessary to add the establishment to the time of the moon's meridian passage on that day. There will also be another high water on the same day, preceding or following that so found by 12h. 26m. nearly. On closer examination it will be found that the interval between the time of the moon's passage over the meridian and the time of high water varies sensibly with the moon's age. At new moon, full moon, first quarter, and third quarter (or rather on the day following each of these phases), the interval between the time of the moon's passage and the time of high water is nearly the same; but from new moon to first quarter, and from full moon to third quarter, the high water occurs earlier than would be inferred by using that same interval; and from first quarter to full moon, and from third quarter to new moon, it occurs later than the same interval would give it. The height at high water and the depression at low water are not always the same. On the days following new moon and full moon, high water is higher and low water lower than at any other time; these are called spring tides. On the days following the first and third quarters, high water is lower and low water higher than at any other time; these are called neap tides. Thus at New York the rise and fall (that is, the difference in elevation between high water and low water) is about 5½ ft. at spring tides, and 3½ ft. at neap tides. At Boston this variation is from 11¼ to 8½ ft. There is a sensible difference in height between two successive high waters or low waters, one occurring before noon, the other after noon, and these differences are most perceptible when the moon is at her greatest declination N. or S., and disappear when she is near the equator. There are other variations of height depending on other circumstances. In a single tide the interval from high water to low water is greater than that from low water to high water; the difference between these intervals is sensibly greater at spring tides than at neap tides. The tidal current in

the bay runs upward for some time after high water, and after changing its direction continues to run downward for some time after low water, when it again changes its direction, and runs upward. If we further examine the state of the tide in different parts of the same river, or in a bay of great length as compared with its breadth, as for instance Chesapeake bay, we shall find that near the mouth there is very little difference between the interval from high to low water and that from low to high water; also that the current runs up the channel for a long time (sometimes approaching to three hours) after high water, and runs down the channel for as long a time after low water. In going up the bay we find that the high water occurs later and later, but the velocity with which the high water travels is so great as entirely to preclude the idea of explaining the tide by supposing the same mass of water to have been moved all the way up the bay. Thus, high water is 13 hours in travelling from Cape Henry to the head of Chesapeake bay, 190 m., moving with an average velocity of 15 m. an hour, while the greatest observed current is less than one mile an hour. High water takes place simultaneously near the head and the mouth of the bay, while it is low water at the same time near the middle. The interval from low water to high water diminishes as we go up the bay, as also the difference between the stand and slack water. At the entrance of the bay the ebb current begins three hours after the high water stand; in the vicinity of Annapolis it is but one hour, and at the head of the bay there is only half an hour between the high water stand and the commencement of the ebb current.—Herodotus speaks of the tides in the Red sea. Plutarch says that Pytheas of Massilia, who had observed them in Britain, ascribed them to the moon. Cæsar, in his account of the invasion of Britain, refers to the nature of spring tides as well understood in connection with the moon's age. Pliny explains the phenomena at some length, and ascribes them to the sun and moon dragging the waters along with them. Kepler in accounting for the tides was evidently aware of the principle of gravitation, but not of the law. Newton laid hold of this class of phenomena as the most incontestable proof of universal gravitation, and showed that according to its law just such periodic fluctuations in the fluid covering of the earth must take place as are actually exhibited by the tides of the ocean. If we conceive the earth to be wholly or in a great degree covered with water, and subject to the attraction of the sun, the force of which is inversely as the square of the distance, it will be obvious that while the whole earth will fall toward the sun with a velocity proportioned to the aggregate attraction upon its solid portions (which is the same as if all the matter were collected at its centre), the water nearest to the sun, being accelerated by a greater force, and being fluid, will approach the sun more rapidly than the solid core. It will thus run from all sides into a protuberance beyond the form of equilibrium of the earth's attraction and rotation, until the pressure of the elevated mass equals the difference in the attraction of the sun. Moreover, a similar protuberance will be formed on the side opposite to the sun, since the particles of water, being solicited by a less force than the solid core, will fall more slowly toward the sun, and as it were remain behind. Nor does the fact that, on the average, the earth does not lessen its distance from the sun, in the least invalidate the force of this reasoning; for the deviations from the tangential motion of the earth in its orbit are precisely those which the earth would move through if falling toward the sun unaffected by any other impulse. The same considerations hold good in regard to the attraction of the moon upon the earth and the waters surrounding it; for although we are in the habit of considering the moon as simply revolving about the earth, it must be remembered that the attraction is mutual, that both bodies describe orbits about their common centre of gravity, and that while the moon obeys the attractive force of the earth, the latter equally follows that of the former, by which it is at every instant of time drawn from the path which it would pursue if that influence did not exist, by an amount precisely equal to the fall corresponding to the moon's attractive force. As a necessary consequence of the elevation of the water in the regions nearest to and most remote from the attracting body, there must be a corresponding depression below the mean level of the sea at points distant 90° from the vertices of the protuberances, or at the sides of the earth as seen from the sun or moon. If the latter bodies maintained a constant position with respect to the earth, the effect would therefore be to produce a distortion of figure in the ocean surface (assumed to cover the whole earth) having the form of a slightly elongated ellipsoid, the two vertices of which would be, the one precisely under, the other precisely opposite to the points at which the disturbing body is vertical. But this is not the case; for by the rotation of the earth and the motion of earth and moon in their orbits, the direction of the disturbing forces is constantly changing with respect to any point on the earth's surface. New points arrive at every instant under the zenith and nadir of either luminary, and thus waves are produced which follow them round the globe. The highest points of these waves will remain far behind the verticals of the disturbing bodies, because the inertia and friction of the water prevent the instantaneous change of form required, and because, although the elevating force is greatest under the vertical, it continues to act in the same direction for some hours after the passage of the luminary, with but little diminished force. This retardation, which would be

sensible under the simple supposition of an uninterrupted ocean covering the earth's surface, becomes very considerable under the actual circumstances of the case.—The depth of the sea varies so much, and the form of its basin, taken as a whole, is so interrupted by the land, that it may be doubted whether, were the action of the sun and moon at once suspended, their tide waves would perform even a single revolution with any sort of regularity. Hence it follows that the tides for the time being may be considered as almost completely commanded by the then actual positions and proximities of the sun and moon, the free oscillations of the sea in its bed being quite subordinate to the forced wave generating them. In consequence (as is always the case in forced oscillations), every periodicity in the action of the forcing cause is propagated in the oscillations, and records itself in the recorded height of the tide on every point of the coast, but at each point at a greater or less interval from the culmination of the sun or moon, according to its local position and the more or less circuitous course taken by the tide wave to reach it, which special observation can alone determine. This interval is called the establishment of the place. The close relation which the times of high water bear to the times of the moon's passage shows that the moon's influence in raising the tides must be much greater than the sun's. In fact, while the whole attraction of the sun upon the earth far exceeds that of the moon, yet, owing to the greater proximity of the latter, the difference between its attraction at the centre of the earth and at the nearest or most remote points of its surface, which produces the tides, is about $2\frac{1}{2}$ times as great as the difference of the sun's attraction at the same points.—There will be two complete lunar tides in every lunar day of 24h. 52m., and also two complete solar tides in every mean solar day. These are known as the semi-diurnal tides, and constitute the principal fluctuations of the sea level. When the sun and moon are in conjunction or opposition, at the time of new or full moon, the effects of both combine to produce the spring tides, when high water is higher and low water is lower than at mean tides by the amount of the solar tide. At quadratures the high water of the sun will combine with the low water of the moon to produce a less fall, and the low water of the sun with the high water of the moon to produce a less rise, than at mean tides; and we have the neap tides, the range of which is less than the mean range by the amount of the solar tide. Thus, at New York, the rise and fall at syzygies is 5·4 ft., at quadrature 3·4 ft., the former being the sum, the latter the difference of the lunar and solar tides; whence we obtain for the effect of the moon 4·4 ft., and for that of the sun 1 ft., or a ratio of 44 to 10. This proportion does not prove to be the same in all parts of the world, and even varies considerably in places not far distant from each other. At Boston the heights are 11·3 and 8·5 ft. respectively, giving a proportion of 7 to 1. On the Atlantic coast of the United States it averages about 5 to 1, while on the E. side of the Atlantic ocean, on the coasts of France and England, it is in many parts 3 to 1. These differences are to be ascribed to the fact that the shore and harbor tides which we observe have in every instance acquired a greater magnitude than the ocean tides, and have been modified in form by the varying slope of the bottom and configuration of the shores. A simple comparison of the range of spring and neap tides will not serve, therefore, as a correct measure of the relative effect of the sun and moon, and hence for a determination of the mass of the moon, which can only be derived from those data by a profound mathematical analysis.—The next variation of the tides to be considered is that dependent on the moon's declination. Were the moon constantly in the plane of the equator, the highest points of the tide waves would also be in that plane, and would consequently produce a series of equal tides at any place either N. or S. of the equator. But it is evident that when she ascends to the north, the vertex of the tide wave will tend to follow her, giving the highest point of one tide in the northern, and the highest point of the opposite tide in the southern hemisphere. Consequently, when the moon has a northern declination, the tide at any place in the northern hemisphere caused by her upper transit will be higher than that caused by the lower transit. This variation in the heights has a period of one lunar day, and is called the diurnal inequality; it reaches its maximum when the moon is at its greatest northern or southern declination, and disappears when it is on the equator, and consequently has a half-monthly period. The variations of height from this cause produce a corresponding inequality in the times of high water. The sun's declination affects the tides in a similar manner, but the amount of the disturbance is very small, and its period extends over half a year. Yet in long series of observations its effect is well marked, both in height and time. The diurnal inequality depending on the moon's declination is on the other hand quite sensible, and in many places constitutes a prominent or even the chief feature of the tides, as on the Pacific coast of North America and in the gulf of Mexico, to the peculiarities of which we shall recur hereafter. If the tides arrive at the same place by two different channels, and one of them is retarded behind the other by six hours, in consequence of travelling a longer route or in shallower water, the semi-diurnal tides will be destroyed by an interference of the waves, that is, by the high water of one being superimposed on the low water of the other; the diurnal inequality, however, will not be destroyed, but merely modified in height and time, leaving a single tide in the lunar day

outstanding, which is always very small in amount. A further cause of variation in the height of the tides is the variation of the distances of the sun and moon, by reason of the ellipticity of their orbits. The efficacy of a heavenly body in raising tides is shown by theory to be inversely proportional to the cube of the distance. Hence the efficacy of the sun will fluctuate between the extremes 19 and 21, taking 20 for its mean value, and that of the moon between 43 and 59. Taking into account this cause of difference, the highest spring tide will be to the lowest neap as 59+21 to 43−19, or as 80 to 24, or 10 to 3; leaving out of consideration the local circumstances of access and depth, which greatly modify these proportions. In the North Atlantic the highest tides are observed a day and a half or two days after the syzygies. At New York, the high water which we observe about 8 o'clock in the evening on the days of full or change are those due to the meridian transit of the moon (and sun) on the preceding day, and the highest tide will not occur until the evening of the following day. At Boston this delay, which is called the retard, or age of the tide, is nearly 36 hours. It is the same at Brest, and the tide wave occupies 10 hours in travelling from Brest up the English channel and Thames to London, making the age of the tide at the latter place 46 hours. This delay, which even at the cape of Good Hope amounts to 14 hours, is still the subject of investigation, and is probably mainly due to friction. The interval between the moon's passage over the meridian of a place and the time of high water, which we have referred to as the establishment of the port, is also called the luni-tidal interval. This interval is constant for each place so far as the lunar tide wave is concerned; but as the actual high water depends upon the combination of the lunar and solar tides, it is subject to a variation which is known as the half-monthly inequality in time. On the day after the spring tides the top of the solar tide wave will be nearly an hour in advance of that of the lunar tide wave, and the two waves will combine to make high water earlier than the moon's alone would bring it; hence the luni-tidal interval is shorter. It will continue to shorten until the moon's transit is later by three hours than when the tide is greatest; it then increases again, passes its mean value when the moon has fallen behind six hours, attains its maximum when it is nine hours later, and again decreases until at the next spring tides it reaches its mean value. The mean of all the luni-tidal intervals for half a month at a port is called its mean or corrected establishment, to distinguish it from the vulgar establishment, which is the luni-tidal interval at full and change. The former is now generally used for finding the time of high water on any given day, and tables are constructed from observations at the principal ports for finding the correction for semi-monthly inequality due to the moon's age. Thus for New York the corrected establishment or mean luni-tidal interval is 8h. 13m., and its least and greatest values are 7h. 52 m. and 8h. 35m. On the Atlantic coast of the United States the range of this inequality is about three fourths of an hour; on the coasts of France and Great Britain it often exceeds an hour and a half. This difference of the half-monthly inequality in time at different places is analogous to the variation in the proportion of spring and neap tides above noticed, and is due to the same causes.—The motion of the water in the tide wave is totally unlike that in an ordinary surface wave, such as the wind produces. When a narrow wave of the latter kind, or a succession of such waves of equal breadths and heights, is formed in deep water, a light floating body, as a cork, revolves either in a vertical circle or an ellipse not very different from one, having the longer axis vertical. But in the tide wave the movement of each particle may be regarded as performed in an excessively elongated ellipse, the shorter axis of which is vertical. The breadth of the tide wave from crest to crest, supposing all the earth covered, would be half the earth's circumference, or 12,500 miles, in comparison with which the depth of the sea is insignificant; and the slightest consideration suffices to show that, as all the water which goes to form the elevated portion must be brought from that depressed, this can only take place by a lateral approach of the vertical sections of the sea when the water is rising, and their recess from each other when falling (*i. e.*, over a quadrant of the globe in either case, which is only another way of expressing an alternating backward and forward horizontal current at any given place), with this peculiarity, that these currents (the flow and ebb current) run most rapidly at the moments of high and low water; the instants of most rapid rise and fall being those of slack water or no current one way or the other. In fact, it is obvious that the surface must be rising most rapidly when the water is setting in equally both ways to, and sinking most rapidly when setting out equally both ways from the place; in neither of which cases can there be any current at the place. The tide wave differs also from a wind wave in another very remarkable point. It affects the whole depth of the ocean equally, from the bottom to the surface, while the wind waves, even in the most violent storms, agitate it to a very trifling depth; for the force which acts to produce the former is exerted equally in every portion of the vertical extent of the water, while those producing the latter are strictly confined to the surface. A tide wave of 4 ft. in total height (between high and low water), which is that of the tide at the atolls of the Indian ocean, advancing over a sea 30,000 ft. deep, implies in each particle an alternate advance and recess of 2,800 ft. in its total extent; but this movement, being

spread over six hours either way, is nowhere very rapid. Where a bay or indentation of the coast presents its opening favorably to the tide wave, and decreases in width from the entrance toward its head, the tides rise higher and higher from the mouth upward. This is due to the concentration of the wave by the approach of the shores, and to the gradual shoaling of the bottom by which a portion of the horizontal motion is transferred into vertical motion, the velocity of the wave being at the same time retarded. This effect is strikingly illustrated by a generalization of the heights of the tides on the Atlantic coast of the United States, developed from the tidal observations made in connection with the United States coast survey. That coast presents in its general outline three large bays: the great southern, from Cape Florida to Cape Hatteras; the great middle, from Cape Hatteras to Siasconset, Nantucket; and the great eastern, from Siasconset to Cape Sable. Referring to the tide table given below, we find at Cape Florida a mean height of 1·5 ft., and as we follow the coast to the northward a gradually increasing height, reaching 7 ft. at Savannah entrance, then decreasing again, with an exception easily explained, to Cape Hatteras, where it is 2 ft. In the middle bay, following the stations on the coast, and omitting those on the bays and sounds, we have a less regular increase to 4·8 ft. at Sandy Hook, and a decrease to 2·7 ft. at Menemsha bight on Nantucket island. The configuration of the eastern bay is less regular, and the correspondence of heights requires closer examination. The recess of Massachusetts bay is well marked by the increase in height, reaching 10 ft. at Boston and Plymouth; but the most striking effect of the convergence of shores and shoaling is exhibited in the bay of Fundy. On a line across its mouth, at the Kennebec river as at Cape Sable, the mean height of tide is 8 ft., while at St. John's, N. B., it rises 19 ft., and at Sackville in Cumberland basin, at the head of the bay, 36 ft., attaining to 50 ft. and more at spring tides. When the wave leaves the open sea, its front slope and its rear slope are equal in length and similar in form. But as it advances into a narrow channel, bay, or river, its front slope becomes short and steep, and its rear slope becomes long and gentle. Hence arise the circumstances noticed in the early part of this article, and illustrated by reference to the Chesapeake bay. At the station near the sea the time occupied by the rise is equal to that occupied by the descent; but at a station more removed from the sea the rise occupies a shorter time than the descent. When the tide is very large compared with the depth of water, this inequality becomes very great; thus in the Severn river, at Newnham, above Bristol (England), the whole rise of 18 ft. takes place in an hour and a half, while the fall occupies 10 hours. As the wave advances over a shoaling bottom, a portion of the horizontal motion is transformed into vertical motion, by which the height of the wave is increased, the most rapid current approaches the greatest rise, and the interval between the stand and slack water is diminished. This exaggeration of the height and current is particularly remarkable whenever the front of the advancing tide wave stretches across the mouth of an estuary with contracting borders, and extensive flats bordering the channel near low-water level; then it produces a bore, or sudden and violent wave of great height, which rushes forward with such impetuosity as to sweep everything before it. Such is the case at the head of the bay of Fundy; likewise in the Hoogly river, in the bay of Bengal; in the Dordogne, where it empties into the Garonne, on the coast of France; and in the Severn river, where at spring tides a bore of 9 ft. in height rushes up stream. In the river Amazon, at the equinoxes (when the equatorial tide is at its maximum), during three consecutive days bores of 12 or 15 ft. high rush up the river with each high water; so that along the course of the stream, up which for 200 m. from its mouth no fewer than eight tide waves are simultaneously advancing, as many as five bores are sometimes at once in progress.—It is easily seen that in the smaller seas, which have little or no communication with the ocean, as the Mediterranean, Black, and Caspian seas, and the North American lakes, the tides must be insensible, as the attraction of the moon is at all times very nearly the same for all parts of them. Near the W. end of the Mediterranean, as at Malaga, a small tide is observable, propagated from the Atlantic ocean through the straits of Gibraltar. Tides are also observable at Venice, but the observations have not been discussed so as to determine whether they arise from a small tide wave proper to the Mediterranean, magnified by travelling up the Adriatic sea, although insensible at its mouth, or whether they are variations due to the winds. Fluctuations of the sea level resembling those of the tides, and causing irregularities in the latter, are often produced by the winds, which in many places have a certain periodicity in their direction and force, as the land and sea breezes in the tropics. They come under consideration here only as complicating the study of the tidal phenomena.—The existing theories, while they suffice for the explanation of the observed facts, are inadequate to the prediction of the phenomena at places where they have not been observed. This arises not from any defect in the principles upon which the theory is based, but from the difficulty of investigating mathematically the motion of fluids, under all the various circumstances in which the waters of the sea and of rivers are found, and from our ignorance of the configuration of the bottom of the sea. The equatorial sea being broken up into three great basins, and open water existing only to the southward of the three great continents, the tides are complicated in

a singular way. In each of these basins the equatorial tide has to take a fresh start from the eastern side with every fresh upper and lower transit of the moon and sun, and is destroyed or confused by reflection on the western coast before the creation of a new wave; while in the open part of the southern ocean the tide wave circulates unimpeded, and spreads into the three oceans up which it runs as a free wave, from S. E. to N. W., overtaking in its progress and compounding with the partial equatorial tides or forced waves proper to either ocean. On approaching the shore, the waves are elevated and retarded by the slope of the bottom, and deflected or crowded together according to the varied configurations of the coasts. It is owing to these complications, together with our ignorance of the laws of friction among the particles of water, and between the water and the bottom, that our theories fail to inform us of the magnitude and time of the tides at any given place. But they determine the periodicity of their phases, and the relative part which each disturbing force bears to the whole, by which we are enabled, by the analysis of a sufficient series of exact observations at any place, to predict the phases of the tides at the same place for any future time, the knowledge of which is of immense importance to navigation. It is only since the beginning of the present century that the science of the tides has made any considerable progress in this direction. The theoretical investigations of Laplace, in the *Mécanique céleste*, and his discussions of the tidal observations at Brest, opened the way. Lubbock and Prof. Whewell contributed largely by the elaborate discussions of large collections of tidal observations, published in the "Philosophical Transactions" of the royal society; and Prof. Airy, in his essay on "Tides and Waves" in the "Encyclopædia Metropolitana," has greatly extended our theoretical conceptions of the subject. More recently still important investigations have been published by Prof. W. Thomson and Mr. W. Ferrel.—The tides on the coasts of the United States have been specially investigated by the late Prof. Bache as superintendent of the American coast survey. In connection with that work he organized an extensive system of exact observations, for the purpose of ascertaining the complicated laws which govern the tides. It will be readily understood that in order to separate the effects of the different causes which modify the phenomena, it is not sufficient to observe merely the heights and times of high and low water, but that a continuous record of the tides is necessary, as the inequalities are constantly shifting their place and magnitude. For this purpose a self-registering tide gauge is used, by which a continuous curve representing the successive changes in the height of water is traced on paper moved by clockwork, by a pencil acted on by the rising and falling of a float in a vertical box, to which the tide has free access. The time scale is such that every hour is represented by one inch, and is pricked into the paper by points on the cylinder which moves the paper forward. A continuous sheet, sufficient for the record of a whole month, is put on the tide gauge at one time. A complete description of this instrument will be found in the coast survey report for 1853. Prof. Bache gave in his annual reports on the progress of the coast survey, from 1851 forward, a series of papers on the tides, detailing the processes of discussion, and giving the results as they were from time to time developed. In these are considered the apparent anomalies in the tides in the gulf of Mexico, exhibiting at some places only one tide in 24 hours; the large inequalities in the tides on the Pacific coast; the general progress of the tide wave along our coasts and in the bays and rivers; the influence of the winds in particular localities; and the action of tidal currents on the bars and channels of our harbors. These labors, which are still in progress, have resulted already in the annual publication of "Tide Tables," giving in advance the times and heights of high and low water at all the principal ports of the United States, for every day in the year. An elaborate discussion of the tides observed at Boston and New York during 19 years, a full lunar cycle, has been made by Mr. William Ferrel of the coast survey, and has resulted in representing the actual tides with unlooked-for precision, yielding moreover a value for the mass of the moon closely approaching that obtained by astronomical methods.—The tides on the coast of the United States, on the Atlantic, gulf of Mexico, and Pacific, are of three different classes. Those of the Atlantic are of the most ordinary type, ebbing and flowing twice in 24 hours, and having but small differences in height between the two successive high or low waters, one occurring before noon, the other after noon. Those of the Pacific coast also ebb and flow twice during 24 hours, but the morning and afternoon tides differ very considerably in height, so much so that at certain periods a rock which has 3½ ft. of water upon it at low tide may be awash (nearly bare) on the next succeeding low water. The intervals, too, between successive high and successive low waters may be very unequal. At San Francisco, for example, at a time when the moon has a large southern declination, the high water occurring about 12 hours after the moon's transit may mark 5 ft. on a tide staff; five hours afterward low water will mark 3½ ft., six hours after which the second high water will reach 7½ ft., and seven hours later the second low water will fall to zero. These inequalities depend upon the moon's declination, in the manner which we have explained; they disappear at the time of the moon's declination being nothing, and are greatest about the time of its being greatest. These tides exhibit the normal type, while those at New York and adjacent parts of the Atlantic coast do not exhibit the diurnal in-

equality. The explanation of this feature is probably to be found in the supposition that the tide wave which advances up into the Atlantic ocean from the continuous tide in the Southern ocean, arrives on our shores 24 hours later than the direct tide wave which crosses the Atlantic from E. to W. In this way the diurnal inequality will be eliminated by the superposition of the two tides, the greater high water of the former coinciding with the lesser of the latter, and *vice versa*, leaving the semi-diurnal tides of equal height. The tide at Galveston, in the gulf of Mexico, furnishes a case of the elimination of the semi-diurnal tide, leaving only the diurnal inequality. It is to be presumed in this instance that the tides reaching Galveston through the straits of Florida and through the passage between Cuba and Yucatan differ by six hours in their periods, causing the low water of one to coincide with the high water of the other, thus sensibly destroying the semi-diurnal tides, except in so far as they are unequal. This leaves a small tide outstanding, having substantially the form of the diurnal inequality, and producing the appearance of the "single day tide," or one high and one low water in every 24 hours. This residual fluctuation is well marked at times when the moon's declination is considerable on either side of the equator, but disappears almost entirely when the moon is near the equator, since at such times the diurnal inequality disappears. Tides of this class have always a small range; in the gulf of Mexico they rarely exceed 2½ ft., and the average rise and fall is but 1½ ft. The tide gauges being in continuous operation, all other fluctuations of the ocean level, besides that produced by the tides, are likewise registered. The tide curves of the western coast are frequently found indented by fluctuations arising from earthquakes. A remarkable instance of this kind was furnished by the earthquake that destroyed the city of Shimoda, Japan, in December, 1854. The time required for the transmission of the sea waves from Shimoda to San Francisco was 12h. 36m. The distance being 4,500 m., the transmission of the wave was at an average rate of 360 m. an hour. The theory of wave motion teaches us that this velocity will be attained by a free-moving wave in a depth of 1,440 fathoms, which may be taken as the average depth of the Pacific between Japan and California. The crests of the waves occurred at intervals of about 23 minutes, corresponding to a length from crest to crest of 150 m. The height when the waves arrived at San Francisco was about 18 in. from hollow to crest. The great earthquake in Peru in August, 1868, was likewise recorded on the tide gauges at San Diego, San Francisco, and Astoria. The fluctuation of the ocean in this instance was very sensible to casual observation, and was noted in Australia, at the Sandwich islands, and at Kodiak, Alaska. The data obtained from these observations, combined with the result before mentioned, indicate that the average depth of the Pacific ocean is about 1,800 fathoms. Such waves, originating with an impulse at one definite point, and propagated freely through the ocean in every direction with a velocity depending upon the square root of the depth of the sea, serve as good illustrations of the manner in which tides are propagated as free waves through sounds, bays, and rivers. The rate of motion for different depths is as follows: at 10 ft., 12·2 m. an hour; 60 ft., 30 m.; 100 ft., 38·7 m.; 1,000 ft., 122·3 m.; 6,000 ft., 299·5 m.

TIDE TABLE FOR THE UNITED STATES.*

| PORTS. | Mean luni-tidal interval. | Rise and fall, spring tides. | Rise and fall, neap tides. |
|---|---|---|---|
| | h. m. | feet. | feet. |
| Eastport, Me | 11 8 | 20·6 | 15·4 |
| Hanniwell's Pt., Kennebec river, Me. | 11 15 | 9·3 | 7·0 |
| Portland, Me | 11 25 | 9·9 | 7·6 |
| Portsmouth, N. H | 11 23 | 9·9 | 7·2 |
| Newburyport, Mass | 11 22 | 9·1 | 6·6 |
| Rockport, " | 10 57 | 10·2 | 7·1 |
| Salem, " | 11 13 | 10·6 | 7·6 |
| Boston light, " | 11 12 | 10·9 | 8·1 |
| Boston, " | 11 27 | 11·3 | 8·5 |
| Plymouth, " | 11 19 | 11·4 | 9·0 |
| Wellfleet, " | 11 5 | 13·2 | 9·2 |
| Provincetown, " | 11 22 | 10·8 | 7·7 |
| Monomoy, " | 11 58 | 5·3 | 2·6 |
| Nantucket, " | 12 24 | 3·6 | 2·6 |
| Hyannis, " | 12 22 | 3·9 | 1·8 |
| Edgartown, " | 12 16 | 2·5 | 1·6 |
| Holmes's Hole, " | 11 43 | 1·8 | 1·3 |
| Tarpaulin Cove, " | 8 4 | 2·8 | 1·8 |
| Wood's Hole, N. side, Mass | 7 59 | 4·7 | 3·1 |
| Wood's Hole, S. side, " | 8 34 | 2·0 | 1·2 |
| Menemsha Bight, " | 7 45 | 3·9 | 1·8 |
| Quick's Hole, N. side, " | 7 31 | 4·3 | 2·9 |
| Quick's Hole, S. side, " | 7 36 | 3·8 | 2·3 |
| Cuttyhunk, " | 7 40 | 4·2 | 2·9 |
| Kettle Cove, " | 7 48 | 5·0 | 3·7 |
| Bird island light, " | 7 59 | 5·3 | 3·5 |
| New Bedford entrance, " | 7 57 | 4·6 | 2·8 |
| Newport, R. I | 7 45 | 4·6 | 3·1 |
| Point Judith, R. I | 7 32 | 3·7 | 2·6 |
| Block island, " | 7 36 | 3·5 | 2·0 |
| Montauk Point, L. I., N. Y | 8 20 | 2·4 | 1·8 |
| Sandy Hook, " | 7 29 | 5·6 | 4·0 |
| New York, " | 8 13 | 5·4 | 3·4 |
| Dobbs Ferry, Hudson river, N. Y | 9 19 | 4·4 | 2·7 |
| Tarrytown, " " | 9 57 | 4·0 | 2·7 |
| Verplanck's Point, " " | 10 8 | 3·8 | 2·5 |
| West Point, " " | 11 2 | 3·2 | 2·0 |
| Poughkeepsie, " " | 12 34 | 3·9 | 2·4 |
| Tivoli, " " | 13 50 | 4·6 | 3·2 |
| Stuyvesant, " " | 15 49 | 4·4 | 3·0 |
| Castleton, " " | 16 55 | 3·0 | 2·3 |
| Greenbush " " | 17 48 | 2·5 | 1·9 |
| Watch Hill, R. I | 9 0 | 3·1 | 2·4 |
| Stonington, Conn | 9 7 | 3·2 | 2·2 |
| Little Gull island, N. Y | 9 38 | 2·9 | 2·3 |
| New London, Conn | 9 28 | 3·1 | 2·1 |
| New Haven, " | 11 16 | 6·2 | 5·2 |
| Bridgeport, " | 11 11 | 8·0 | 4·7 |
| Oyster Bay, L. I., N. Y | 11 7 | 9·2 | 5·4 |
| Sand's Point, " " | 11 13 | 8·9 | 6·4 |
| New Rochelle, N. Y | 11 22 | 8·6 | 6·6 |
| Throg's Neck, " | 11 20 | 9·2 | 6·1 |
| Cold Spring inlet, N. J | 7 32 | 5·4 | 3·6 |
| Cape May landing, " | 8 19 | 6·0 | 4·3 |
| Delaware breakwater, Del | 8 0 | 4·5 | 3·0 |
| Higbee's, Cape May, N. J | 8 33 | 6·2 | 3·9 |
| Egg island light, " | 9 4 | 7·0 | 5·1 |
| Mahon's river, Del | 9 52 | 6·9 | 5·0 |
| New Castle, " | 11 58 | 6·9 | 6·6 |
| Philadelphia, Pa | 13 44 | 6·8 | 5·1 |
| Old Point Comfort, Va | 8 17 | 3·0 | 2·0 |

* The mean interval in column 2 has been increased by 12h. 26m. (half a mean lunar day) for some of the ports in Hudson river, Delaware river, and Chesapeake bay, so as to show the succession of times from the mouth.

| PORTS. | Mean luni-tidal interval. | Rise and fall, spring tides. | Rise and fall, neap tides. |
|---|---|---|---|
| | h. m. | feet. | feet. |
| Point Lookout, Md................ | 12 58 | 1·9 | 0·7 |
| Annapolis, " ................ | 17 4 | 1·0 | 0·8 |
| Bodkin light, " ................ | 18 8 | 1·3 | 0·8 |
| Baltimore, " ................ | 18 59 | 1·5 | 0·9 |
| Washington, D. C.................. | 20 10 | 3·4 | 2·6 |
| James river (City Point), Va........ | 14 37 | 3·0 | 2·5 |
| Richmond, " ....... | 16 54 | 3·4 | 2·3 |
| Tappahannock, " ....... | 12 58 | 1·9 | 1·3 |
| Hatteras inlet, N. C................ | 7 4 | 2·2 | 1·8 |
| Beaufort, " ................ | 7 26 | 3·3 | 2·2 |
| Bald Head, " ................ | 7 26 | 5·0 | 3·4 |
| Smithville, " ................ | 7 19 | 5·5 | 3·8 |
| Wilmington, " ................ | 9 6 | 3·1 | 2·2 |
| Georgetown entrance, S. C......... | 7 56 | 4·7 | 2·7 |
| Bull's island bay, " ......... | 7 16 | 5·7 | 3·7 |
| Charleston, " ......... | 7 26 | 6·0 | 4·1 |
| St. Helena sound, " ......... | 7 8 | 7·4 | 4·4 |
| Fort Pulaski, Ga.................. | 7 20 | 8·0 | 5·9 |
| Savannah, " .................. | 8 13 | 7·6 | 5·5 |
| Doboy lighthouse, Ga.............. | 7 33 | 7·8 | 5·4 |
| St. Simon's, " .............. | 7 43 | 8·2 | 5·4 |
| Fort Clinch, Fla.................. | 7 53 | 6·7 | 5·3 |
| St. John's river, Fla.............. | 7 28 | 5·5 | 3·7 |
| St. Augustine, " .............. | 8 21 | 4·9 | 3·6 |
| Cape Florida, " .............. | 8 34 | 1·8 | 1·2 |
| Indian Key, " .............. | 8 23 | 2·2 | 1·3 |
| Sand Key, " .............. | 8 40 | 2·0 | 0·6 |
| Key West, " .............. | 9 30 | 1·5 | 0·9 |
| Tortugas, " .............. | 9 56 | 1·5 | 0·6 |
| Tampa bay (Egmont Key), Fla..... | 11 21 | 1·8 | 1·0 |
| Cedar Keys (Depot Key), " .... | 13 15 | 3·2 | 1·6 |
| St. Mark's, . " .... | 13 38 | 2·9 | 1·4 |
| WESTERN COAST. | | | |
| San Diego, Cal.................... | 9 38 | 5·0 | 2·3 |
| San Pedro, " .................... | 9 39 | 4·7 | 2·2 |
| Cuyler's harbor, Cal............... | 9 25 | 5·1 | 2·8 |
| San Luis Obispo, " ............... | 10 8 | 4·8 | 2·4 |
| Monterey, " ............... | 10 22 | 4·3 | 2·5 |
| South Farallone, " ............... | 10 37 | 4·4 | 2·8 |
| San Francisco, " ............... | 12 6 | 4·3 | 2·8 |
| Mare island, " ............... | 13 40 | 5·2 | 4·1 |
| Benicia, " ............... | 14 10 | 5·1 | 3·7 |
| Ravenswood, " ............... | 12 36 | 7·3 | 4·9 |
| Bodega, " ............... | 11 17 | 4·7 | 2·7 |
| Humboldt bay, " ............... | 12 2 | 5·5 | 3·5 |
| Port Orford, Oregon............... | 11 26 | 6·8 | 3·7 |
| Astoria, " ............... | 12 42 | 7·4 | 4·6 |
| Nee-ah harbor, Washington territory | 12 33 | 7·4 | 4·8 |
| Port Townshend, " " | 3 49 | 5·5 | 4·0 |
| Steilacoom, " " | 4 46 | 11·1 | 7·2 |
| Semi-ah-moo bay, " " | 4 50 | 6·6 | 4·8 |

TIDE TABLE FOR SOME OF THE PRINCIPAL PORTS AND HEADLANDS OF THE WORLD,

Giving the vulgar establishment or time of high water at full and change, and the rise and fall or whole range at spring and neap tides, except for the United States.

| PLACES. | Time of H. W. at full and change. | Range at spring tides. | Range at neap tides. |
|---|---|---|---|
| EAST COAST OF ATLANTIC OCEAN. | h. m. | feet. | feet. |
| Simon's bay, Cape of Good Hope... | 2 44 | 5¼ | 2¼ |
| St. Helena island.................. | 3 11 | 3 | 1½ |
| St. Paul de Loanda, Africa......... | 4 30 | 5 | .... |
| Sierra Leone, " ......... | 7 55 | 8 | .... |
| Cape Verd, " ......... | 7 45 | 5 | .... |
| Ceuta, straits of Gibraltar.......... | 2 6 | 3¾ | 1¼ |
| Gibraltar, old mole................ | 2 20 | 3½ | .... |
| Fayal, Azores..................... | 11 45 | 4 | .... |
| Cape Finisterre, Portugal.......... | 3 0 | 15 | .... |
| Bordeaux, France.................. | 6 50 | 14 | 11½ |
| Brest, " .................. | 3 47 | 19 | 8½ |
| St. Malo, " .................. | 6 5 | 35 | 17 |
| Cherbourg, " .................. | 7 49 | 17 | 8½ |
| Havre, " .................. | 9 51 | 22 | 14 |
| Calais, " .................. | 11 49 | 19½ | 11½ |
| Dover, England.................... | 11 12 | 18¼ | 11¼ |
| Portsmouth dockyard, England.... | 11 41 | 12½ | 7½ |
| Plymouth breakwater, " .... | 5 37 | 15½ | 7½ |
| Scilly isles, St. Agnes, England..... | 4 30 | 16 | 8 |
| Bristol (King road), " .... | 6 65 | 44 | 22 |
| Liverpool, " .... | 11 23 | 26 | 14½ |
| Glasgow, Scotland................. | 1 25 | 9 | 6 |
| Stromness, " ................. | 9 0 | 10 | 5 |
| Aberdeen, " ................. | 1 0 | 12 | 8 |
| Leith, " ................. | 2 17 | 16½ | 9 |
| Hull, England..................... | 6 29 | 20¾ | 11¾ |
| Yarmouth roads, England.......... | 9 15 | 6 | 2 |
| Margate, " .......... | 11 40 | 15½ | 10½ |
| London docks, " .......... | 1 57 | 19½ | 14½ |
| Cape Clear, Ireland ............... | 4 0 | 9 | 4 |
| Cork (Penrose quay), Ireland...... | 4 58 | 12¾ | 7½ |
| Dublin bar, " ...... | 11 12 | 12–14 | 7–9 |
| Galway, " ...... | 4 35 | 14¾ | 7½ |
| Ostend, Belgium.................. | 12 25 | 19 | 11 |
| Texel (outside shoals), Holland.... | 6 30 | 4 | 3 |
| Helgoland, Elbe entrance.......... | 11 33 | 9½ | 4½ |
| Loffoden islands, Norway.......... | 12 0 | 9 | 6 |
| Keret's point, gulf of Archangel.... | 4 30 | 5½ | .... |
| WEST COAST OF ATLANTIC OCEAN. | | | |
| Cape Horn islands, South America. | 3 50 | 8 | .... |
| Santa Cruz river, " " | 9 30 | 40 | 18 |
| Rio Janeiro, " " | 3 0 | 4 | 2 |
| Cape St. Roque, " " | .... | 8–10 | .... |
| Maranham, " " | 7 0 | 17½ | .... |
| Cartagena, " " | 11 0 | 1½ | ½ |
| Cape St. Antonio, Cuba ........... | .... | 1½ | .... |
| Bermudas, dockyard............... | 7 14 | 4 | .... |
| Greytown, Nicaragua ............. | 9 0 | 1½ | .... |
| Vera Cruz, Mexico................ | .... | 2 | .... |
| Cape Sable, Nova Scotia........... | 8 30 | 9 | 4 |
| St. John's, New Brunswick........ | 11 23 | 23 | 17 |
| Sackville, " " ........ | 11 48 | 50 | 24 |
| Halifax harbor, Nova Scotia........ | 7 49 | 6 | 2 |
| Quebec, Canada................... | 6 38 | 18 | 8 |
| St. John's, Newfoundland ......... | 7 30 | 7 | .... |
| Upernavik, Greenland............. | 11 0 | 8 | .... |
| Van Rensselaer bay, Greenland.... | 11 50 | 11 | 4½ |
| INDIAN OCEAN AND WEST COAST OF PACIFIC. | | | |
| Mozambique harbor, Africa........ | 4 15 | 12 | .... |
| Bab-el-Mandeb, Red sea........... | 12 30 | .... | .... |
| Suez bay, head of gulf, Red sea .... | 2 0 | 6 | .... |
| Surat, Hindostan ................. | 4 0 | 19 | .... |
| Bombay, dockyard, Hindostan..... | 11 40 | 12–17 | .... |
| Maldives, Adou atoll .............. | 1 0 | 4 | .... |
| Trincomalee harbor, Ceylon........ | 8 18 | 2 | 1 |
| Madras road, Hindostan........... | 7 34 | 3½ | .... |
| Western entrance to Hoogly river. | 10 0 | 10¾ | ... |
| Singapore, new harbor ............ | 9 45 | 10 | 5 |
| Batavia, Java..................... | 10 0 | 2 | .... |
| Canton river (entrance), China..... | 10 0 | 8 | .... |
| Yangtse-kiang (entrance), China... | 12 0 | 15 | 5 |
| Nagasaki bay, Japan.............. | 6 28 | 6½ | .... |
| Sydney, Australia................. | 8 38 | 4¾ | 3½ |
| Melbourne, " ................. | 1 20 | 3 | .... |
| Tahiti or Otaheite island.......... | noon | 1 | .... |
| Honolulu, Sandwich islands........ | 4 0 | 2 | .... |
| EAST COAST OF PACIFIC OCEAN. | | | |
| Cape Virgin, strait of Magellan .... | 8 30 | 36–42 | .... |
| Cape Horn ....................... | 4 40 | 9 | .... |
| Valparaiso, Chili.................. | 9 32 | 5 | .... |
| Callao bay, Peru .................. | 5 47 | 4 | .... |
| Guayaquil, Ecuador............... | 7 0 | 11 | .... |
| Panama road, Colombia........... | 8 23 | 15–22 | 5–10 |
| Port la Union, gulf of Fonseca..... | 8 15 | 10¾ | 6¾ |
| Mazatlan, Mexico ................ | 9 40 | 7 | .... |

A study of the preceding tables, with the aid of a map, will develop many interesting facts with regard to the propagation of the tide wave and the effect of the configuration of the coasts on the time and height of the tides. It will be seen, for example, that high water occurs nearly at the same time at the headlands of the great middle and eastern bays of

the Atlantic coast of the United States—at Cape Hatteras, Nantucket island, and Cape Sable—making an allowance for the difference in local time. If by a line on the map we connect these points at which high water occurs simultaneously, we may regard that line as representing the crest of a tide wave advancing upon the coast. We shall find high water to occur later and later as we go up into the bays and rivers; and by following up the progress of the waves, we may be enabled to draw lines representing the time of high water or the top of the wave for each successive hour. Such lines are called co-tidal lines, and have been traced for the coasts of the United States by Prof. Bache, for which we again refer to the coast survey reports. A chart of co-tidal lines for the British isles, by Prof. Whewell, will be found in Keith Johnston's "Physical Atlas," as well as a chart of co-tidal lines for the whole globe; but the latter must be looked upon as a rather adventurous generalization, in the absence of any positive knowledge of the tides in mid-ocean. The tides about the British isles present a very interesting study. The advancing high water passes up the English channel, occupying six hours from the Scilly isles to the mouth of the Thames, where it is met and reënforced by the high water 12 hours older, which has travelled around the isles to the northward and down the North sea. There is a point in the latter, about midway between Yarmouth and the Texel, where the co-tidal line of nine hours of the latter tide wave intersects that of three hours of the former, causing the interference of low water of the one with high water of the other tide, in consequence of which no change takes place in the sea level, as has been ascertained by actual observations over a shoal spot in that locality. A remarkable case of the meeting of two tides, which will be more particularly noticed below, occurs near Throg's Neck at the W. end of Long Island sound.—The agency of tidal currents in producing changes in the entrances of bays and harbors is a subject of the first importance to commerce and navigation, which has received full attention in the prosecution of the American coast survey. As on the average the same amount of water moves inward and outward with the flood and ebb tides, we might readily suppose that the same amount of material is transported either way, and that no important change would take place in the configuration of the bottom. But the operation of the flood stream is very different from that of the ebb stream. We have as a general feature an interior basin of some extent communicating with the sea by a comparatively narrow passage. The flood stream, therefore, running with considerable velocity through this channel, will as it enters the basin spread out and become slow, depositing the sand and mud it is charged with, and making extensive flats or shoals opposite the entrance. The ebb stream runs slowly over the flats from all directions toward the opening, without removing much of the deposit, and gradually concentrates in definite narrow channels, which it scoops out, and the depth of which will depend in a great degree on the proportion of the area of the basin to the outlet, or, in other terms, on the difference of level which will be reached during the ebb between the basin and the ocean, which determines the greatest velocity and transporting power reached by the ebb stream. On the bars of most of the sand-barred harbors on our southern coast, the place and direction of the channel are frequently changed during violent storms, when the direction of the waves happens to be oblique to that of the channel; or when the sea runs directly upon the channel, the depth of water may be considerably diminished for the time being, by the sand rolled up by the waves. But in all these cases it is found that the normal depth is speedily restored by the scour of the ebb tide, which depends upon the unchanged factors of area and form of basin, height of tide, and character of the material forming the bar. To illustrate the important subject of tidal currents, we will examine the hydraulic system of New York harbor. Considering first the progress of the tide wave through Long Island sound from the eastward to its meeting with that entering New York bay at Sandy Hook, we see that about 7½ hours after the transit of the moon high water has advanced just within Block island with an elevation of 2 ft., and at the same time has just passed Sandy Hook with an elevation of 4½ ft. Traversing the sound westward with increasing heights, it reaches Sand's Point three hours later with a height of 7·7 ft. The observed time of transmission from the Race to Sand's Point is 2h. 1m., and the time computed from the depths according to the law developed by Airy is 2h. 14m.; a very good approximation when we consider the irregularities in the configuration of the sound, which could not be taken into account. Advancing still further, the height somewhat declines in consequence of the changes of direction in the channel and its shallowness. At Hell Gate this tide wave is met by that which had entered at Sandy Hook, and advanced more slowly owing to the narrowness and intricacies of the channel, especially in the East river. These two tides which meet and overlap each other at Hell Gate, differing in times and heights, cause contrasts of water elevations between the sound and harbor which call into existence the violent currents that traverse the East river. The conditions of the tidal circulation through Hell Gate are such that if there were a partition across it, the water would sometimes stand nearly 5 ft. higher, and at other times 5 ft. lower on the one side than on the other. In the actual case of the superposition or compounding of the two tides, the difference of level existing at any time is of course much less, but the difference of one foot is often

observed within the space of 100 ft. in the most contracted portion of Hell Gate off Hallett's Point. The entrance from Long Island sound is a natural depression or arm of the sea which is not changed by the forces now in operation. The tidal currents which flow through it do not change the channel, but are obliged to follow it in its tortuous course. The Sandy Hook entrance, on the contrary, is characterized by a cordon of sands extending from Sandy Hook to Coney island, intersected by channels, which are maintained against the action of the sea, which tends to fill them up, by the scour of the ebb tide from the tidal basin of New York harbor. The advance of Sandy Hook upon the main ship channel is among the notable and important instances of the effect of tidal currents; within a century it has increased a mile and a quarter. In the place where the beacon on the end of the Hook now stands there was 40 ft. of water 15 years before it was built. The cause of this growth is a remarkable northwardly current along both shores of the Hook, running both during the flood and the ebb tides with varying rates, and resulting from those tides directly and indirectly. The best water over the bar is about 2 m. E. of Sandy Hook light, in a direct line with the Swash channel; the greatest depth over it is 22 ft. at mean low water, and the same depth can now be carried through the Swash channel, which formerly was 3 ft. shallower, but has deepened since the cross section between the Hook and Flynn's knoll has been diminished by one third its area by the growth of the Hook. This relative change in the capacity of the channels has not affected the depth on the outer bar, which, according to the principles above laid down, is dependent mainly upon the area of the tidal basin within. The depth of 22 ft. at mean low water, which is now maintained at the entrance, through the sands constantly thrown up by the waves of the sea, may be considered as depending upon the following elements: 1, the large basin between Sandy Hook and Staten island, including Raritan bay, which furnishes more than one half of the whole ebb scour; 2, what is called the Upper bay, including the Jersey flats and Newark bay; 3, the North river, perhaps as far as Dobbs Ferry, maintaining the head of the ebb current, although not directly taking part in the outflow; and 4, a portion of the sound tide, which flows in through Hell Gate. The proportion of the first three divisions in producing the depth of channel may be approximately estimated by a comparison of the areas and distances from the bar. In order to maintain the depth which we now have, it is important that the area of the tidal basin should not be encroached upon. In proportion as that is diminished the depth of the channels will decrease. The flats, just bare at low water, but covered at high tide, form as important a part as any other portion, for it is obvious that it is only the volume of water contained between the planes of low and high water, the "tide prism," that does the work in scouring the channels. The water on the flats is especially useful by retarding the outflow, thus allowing a greater difference of level to be reached between the basin and the ocean. The part which the fourth division in our classification of the basin of New York, that of the East river and Hell Gate passage, plays in the outflow of the ebb tide through the Sandy Hook channels, depends less upon the area involved than upon the difference in point of time and height of tide in Hell Gate already adverted to. The westerly current, usually called the ebb stream since it falls in with the ebb stream of New York harbor, taking place when the sound tide is highest, starts from a level 3½ ft. higher than the easterly, and thus a much larger amount of water flows out through the Sandy Hook channels than through the narrows at Throg's Neck. It is apparent, then, that this portion of the ebb stream, reënforcing the ebb stream of the harbor proper at the most favorable times, performs a most important part in maintaining the channels through the Sandy Hook bar.

**TIECK. I. Ludwig**, a German author, born in Berlin, May 31, 1773, died there, April 28, 1853. He completed his studies at Halle, and became known in 1795 as a writer of fantastic novels. His antagonism to the literary tendencies of the time was displayed in *Peter Lebrecht* (2 vols., 1795–'6), and in *Peter Lebrecht's Volksmärchen* (3 vols., 1797), several of which, as *Der gestiefelte Kater* ("Puss in Boots"), *Blaubart* ("Bluebeard"), and *Leben und Tod des kleinen Rothkäppchen* ("Life and Death of Little Red Riding Hood"), combine the simplicity of the old legends with grotesque satire upon modern subjects. The classicists were the particular objects of his brilliant raillery, especially in his *Herzensergiessungen eines kunstliebenden Klosterbruders* (1797), written in conjunction with Wackenroder, and *Franz Sternbald's Wanderungen* (2 vols., 1798), and in his comedies *Die verkehrte Welt* ("The Topsy-turvy World") and *Prinz Zerbino, oder die Reise nach dem guten Geschmack* ("Travels after Good Taste"). The *Leben und Tod der Genovera* (1800) is esteemed his finest drama. Meantime he had married at Hamburg a niece of the composer Reichardt, had become associated with the Schlegels, Novalis, and Steffens at Jena, and with Herder at Weimar, and prepared an admirable translation of "Don Quixote" (4 vols., Berlin, 1799–1801). He published at Dresden in 1802, with A. W. von Schlegel, the *Musenalmanach*. After examining at Rome the manuscripts of German mediæval literature, he returned in 1806 to Munich, and for several years he was disabled by the gout. In 1817 he visited England to complete his studies of Shakespeare and the Elizabethan age. In 1819 he settled at Dresden. In 1820 he was invited by the king of Prussia to Berlin, where, as in Dresden, he exerted great influence on the

drama, and the "Antigone" of Sophocles was performed under his auspices. His works include *Minnelieder aus dem schwäbischen Zeitalter* (1803); *Ulrichs von Lichtenstein Frauendienst* (1815); the celebrated novels *Dichterleben*, *Der Tod des Dichters*, and the unfinished *Aufruhr in den Cevennen* (1826); *Shakspeare's Vorschule*, a translation of plays which he regarded as early works of Shakespeare, and *Dramaturgische Blätter* (2 vols., 1826). He also supervised his daughter Dorothea's and Count Baudissin's continuation of Schlegel's translation of Shakespeare, and edited various poems. The latest edition of his poems is in 3 vols. (1841), and of his novels in 12 vols. (1853). Nearly complete editions of his works include 20 vols. (1828–'42). Carlyle translated several of his tales in vol. i. of his "Specimens of German Romance;" a second edition of those tales, in another English version, appeared at London in 1860. Tieck's biographer Köpke edited his posthumous writings (2 vols., Leipsic, 1855).—See Friesen's *Ludwig Tieck* (2 vols., Vienna, 1871). **II. Christian Friedrich**, a German sculptor, brother of the preceding, born in Berlin, Aug. 14, 1776, died there, May 14, 1851. He studied under Schadow and in Paris under David, and was employed at Weimar from 1801 to 1805, and subsequently in Italy till 1819, when he became a member of the academy at Berlin, coöperating with Schenkel and Rauch in improving the art of sculpture. His works include many busts in the Walhalla, executed at Carrara by order of the crown prince and future king Louis of Bavaria; those of Goethe and other poets at Weimar; the statue of Necker for Mme. de Staël; decorations of the royal theatre at Berlin and other public buildings; and the statue of his brother at Dresden.

**TIEDEMANN. I. Dietrich**, a German philosopher, born at Bremervörde, Hanover, April 3, 1748, died in Marburg, Sept. 24, 1803. He studied at Göttingen, and taught ancient languages at Cassel from 1776 to 1786, when he became professor of philosophy at Marburg. He combined the principles of Locke and Leibnitz. His *Untersuchungen über den Menschen* (3 vols., Leipsic, 1777–'98), *Theätet* (Frankfort, 1794), *Idealistische Briefe* (Marburg, 1798), and *Handbuch der Psychologie* (edited by Wachler, Leipsic, 1804), are interesting on account of their investigations in psychology and on the subject of cognition. But his fame rests on his history of philosophy from Thales to Wolf in his *Geist der speculativen Philosophie* (6 vols., Marburg, 1791–'7). **II. Friedrich**, a German physiologist, son of the preceding, born in Cassel, Aug. 23, 1781, died in Munich, Jan. 22, 1861. He graduated in medicine at Marburg in 1804, and was professor of anatomy and zoölogy at Landshut from 1806 to 1816, and afterward at Heidelberg till 1849. His numerous works include *Zoologie* (3 vols., Landshut, 1808–'10); *Anatomie des Fischherzens* (1809); *Anatomie und Bildungsgeschichte des Gehirns* (Nuremberg, 1816); and *Die Physiologie des Menschen* (Darmstadt, vols. i. and iii., 1830–'36).

**TIEDGE, Christoph August**, a German poet, born at Gardelegen, Prussia, Dec. 14, 1752, died in Dresden, March 8, 1841. He studied at Halle, and led a precarious life as a clerk in the civil service and as a private tutor and secretary till 1805, when he accompanied the countess Elisa von der Recke in her travels. Subsequently he resided with her at Dresden and Berlin; and at her death in 1833 she directed her establishment to be kept up for him without change. His most celebrated poem is *Urania*, on the immortality of the soul (Halle, 1801; 18th ed., Leipsic, 1862). He also published *Elegien und vermischte Gedichte* (Halle, 1803; 2d ed., 2 vols., 1814). His complete works are in 10 vols. (Leipsic, 1841). Falkenstein published Tiedge's *Leben und poetischer Nachlass* (4 vols., Leipsic, 1841), and Eberhard *Blicke in Tiedge's und in Elisa's Leben* (Berlin, 1844). The Tiedge charitable literary institute at Dresden, originally founded for local purposes, has since 1860 extended its operations all over Germany.

**TIENTSIN, Teentsin**, or **Tiensing**, a town of China, in the province of Chihli, on level ground at the junction of the Pei-ho with the grand canal, about 65 m. S. E. of Peking; pop. differently estimated from 400,000 to 930,000. It is surrounded by a wall about 4 m. in circuit, and entered by four gates. The principal streets lead from these gates to the centre of the town, and are broad and well paved. The houses are of unburned brick or mud, and have a mean appearance, though some of them are commodious and well furnished. The river is crossed by a bridge of boats, and large suburbs extend for a considerable distance along both banks. Tientsin derives its importance from being the terminus of the grand canal and the port of Peking, and is said to have been formerly a place of great wealth and extensive trade; but since the banks of the canal were broken by the inundation of the Hoang-ho the trade has declined greatly. Treaties were concluded here in 1858 between the Chinese government and the plenipotentiaries of England, France, Russia, and the United States, by which it became one of the 13 ports open to foreign commerce. In 1873 the imports amounted to $27,602,314; exports, $12,240,602.

**TIERRA DEL FUEGO** (Sp., "Land of Fire"), a group of islands off the S. extremity of South America, between lat. 52° 40′ and 56° S., and lon. 63° 40′ and 75° W. It is separated from the mainland by the straits of Magellan, and has the Pacific ocean on the west and the Atlantic on the east, while the E. and W. limits of these seas are supposed to meet at Cape Horn, its S. extremity. The group comprises numerous small islands, of which Cape Horn is the most remarkable; the large island Tierra del Fuego proper, of very irregular shape and nearly 300 m. long E. and W.; the isl-

ands of Navarin and Hoste to the south, separated from the last named by the Beagle channel; and Dawson, Clarence, and Desolation islands to the west. All these islands are deeply indented. They are mountainous, and many of the peaks are more than 5,000 ft. high, while the highest, Mt. Sarmiento, is about 6,900 ft. The limit of perpetual snow is about 4,000 ft. The soil is generally a swampy peat, and to the height of 1,500 ft. is covered with forests of beech. The geological formation is principally clay slate, greenstone, and granite. The climate is one of the worst in the world; storms, sudden gusts of wind, rain, snow, and mist constantly succeed each other. The gigantic seaweed *macrocystis pyrifera* is common on the coasts and in the straits, and affords shelter for innumerable shell fish, without which the natives would find it extremely difficult to subsist. Deer, guanacos, foxes, sea otters, mice, bats, and a few other animals are found, and birds, particularly sea fowl, are numerous. The natives are of the same race as the Patagonians, but smaller, and those of the S. E. portion of the group are short, ill made, and ill looking. Their clothing consists entirely of guanaco or seal skin. Their huts, generally built close to the shore in some sheltered spot, are conical, made of branches or small trees stuck in the earth, 7 or 8 ft. in diameter and 4 or 5 ft. in height, with a small hole for a door. —Tierra del Fuego was discovered by Magalhaens in 1520, and received its name from the numerous fires seen during the night along the shore. (See Magellan, Straits of.)

**TIERS ÉTAT.** See States General.

**TIFFANY, Louis C.** See p. 909.

**TIFFIN,** a city, county seat of Seneca co., Ohio, on the Sandusky river, 77 m. N. by W. of Columbus; pop. in 1870, 5,648. Four railroads intersect here: the Cincinnati, Sandusky, and Cleveland; Toledo, Tiffin, and Eastern; Mansfield, Coldwater, and Lake Michigan; and Baltimore, Pittsburgh, and Chicago. There are important manufactories, including one of agricultural implements, one of woollens, one of steam engines, &c., two of shoes, two of sash, doors, and blinds, one of wagon hounds, one of furniture, one of stoves, and one of carriages. The city has a national bank, a savings bank, five public schools, one daily and four weekly (one German) newspapers, and 11 churches. It is the seat of Heidelberg college and theological seminary, founded by the German Reformed church in 1850. The college has classical and scientific courses. In 1874-'5 there were 10 instructors (2 theological) and 221 students (13 theological, 102 collegiate, and 106 preparatory); the libraries contained 5,000 volumes.

**TIFLIS. I.** A government of Asiatic Russia, in Transcaucasia, comprising the central part of the former kingdom of Georgia; area, 15,614 sq. m.; pop. in 1871, 606,584. (See Georgia.) **II.** A city, capital of the government, and formerly of Georgia, on the river Kur, 1,100 ft. above the level of the Black sea, in lat. 41° 41′ N., lon. 44° 50′ E.; pop. estimated at 60,000, composed of Russians, Georgians, Armenians, Persians, Jews, Germans, and French. It occupies a long stretch of uneven ground on both sides of the Kur, and is almost surrounded by an amphitheatre of brown barren hills. It is a mixture of Asiatic and European architecture. The modern quarter is laid out in broad streets and open squares, and contains the grand-ducal palace, the theatre, public buildings, and residences of the authorities. The old part of the town has narrow unpaved lanes and alleys, mud or sun-baked brick houses with flat roofs and few windows, and vaulted bazaars, and in it is concentrated all the life and business of Tiflis. The town is the headquarters of an army of 150,000 men, employed in frontier duty, in surveillance of the tribes, and to a great extent in making roads. Tiflis is celebrated for its warm baths. The mineral springs are chiefly at the S. end of the city, and the temperature of the hottest is 115° and that of the coldest 75°. These waters are said to be very beneficial in cutaneous disorders and rheumatic complaints. The climate is exceedingly hot, and bilious diseases prevail. The manufactures consist of carpets, shawls, &c.; and a considerable trade is carried on with Persia. A railway, following the upper course of the Kur and the lower of the Rion or Phasis, connects Tiflis with Poti on the Black sea.—Tiflis

Tiflis.

was founded in the 5th century by a monarch named Vakhtang, who conquered the territory lying between the Black and Caspian seas, and was the capital of the nominally independent kingdom of Georgia, though devastated by Genghis Khan, and frequently in the possession of the Turks or Persians. Aga Mohammed Khan, shah of Persia, destroyed it in 1795, and reduced a large portion of the inhabitants to slavery. The last king of Georgia ceded it to Russia in 1801, since which its population has more than doubled. An insurrection broke out on June 27, 1865, but was soon suppressed.

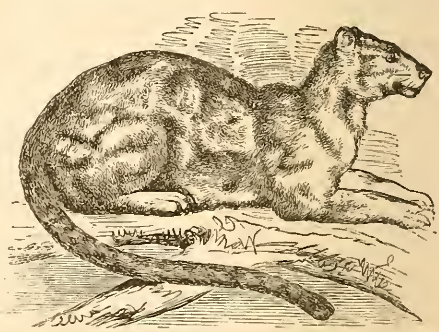
**TIGER** (*felis tigris*, Linn.), one of the largest, strongest, and most active of the cat family, peculiar to Asia. It is usually about 8 ft. long and between 3 and 4 ft. high, but occasionally is considerably larger; the ground color is bright orange yellow, the face, throat, and under parts nearly white, and all elegantly striped with transverse black bands and bars;

Tiger (Felis tigris).

it is less high but longer and more slender than the lion, with rounder head and more cat-like form; the colors are brightest in the adult male, the young being grayish with obscure dusky bands; it has no mane. It lies in ambush at early dawn by the sides of springs and rivers for animals as they come to drink; it is able to leap a great distance upon its prey, carrying off a buffalo with apparent ease, a powerful man being as nothing in its jaws; its motions are exceedingly supple and graceful; it passes the day for the most part in a shady covert, gorged and sleepy from the morning meal. Its north and south geographical range is extensive, from northern China to the Malay peninsula, but it is most abundant in the vast jungles lining the banks of the great rivers of Hindostan. In many parts of Bengal it is the terror and scourge of villages, prowling around the outskirts, and attacking cattle in the fold and on the road, though the natives protect them in part by noisy drums by day and torches by night; men and women frequently fall victims. The English rifle has nearly cleared the thickly settled districts of these animals, against which the native traps and weapons (spears and poisoned arrows) are comparatively powerless. The tiger makes no noise comparable to the roar of the lion, but rather a loud grunting sound. It may be tamed when taken young, but its temper cannot be depended on; it breeds in captivity, though less frequently than the lion; hybrids between the Asiatic lion and tigress have been born in menageries, but have not reached maturity; their color is brighter and the bands better marked than in young lions or tigers of unmixed race. Pliny says the first tiger known in Rome was a tame one belonging to the emperor Augustus.—See Capt. Shakespear's "Wild Sports of India" (London and Boston, 1860), and "The Royal Tiger of Bengal, his Life and Death," by J. Fayrer, M. D. (London, 1875).—The so-called American tiger is the jaguar (*F. onca*, Linn.).

**TIGER BEETLE.** See Beetle.

**TIGER CAT,** a name commonly applied to several small species of *felinæ*, in America, Asia, and Africa, especially to those ornamented by bands and bars. Among the American species, the ocelot has been described under that title, and under the same the margay (*felis tigrina*, Linn.). The *F. eyra* (Desm.) is called tiger cat; it is about the size of the house cat, but with longer neck, body, and tail; it is uniform brownish red, with under jaw and nose spot white, paler below; like the ocelot, it comes from Guiana and as far north as Mexico and Texas. The *F. yaguarundi* (Desm.) is larger, with a much longer body; it is grizzled brownish gray without spots; hairs ringed and tipped with black; the young more rufous; it extends from Paraguay to Texas. Both of these cats frequent woods and thickets, feeding on small mammals and birds, and are excellent climbers. The chati (*F. mitis*) of South America is also sometimes called tiger cat. (See Chati.)—There are several tiger cats in Asia, of which the largest and handsomest is the rimau-dahan (*F. macrocelis*, Temm.).



Rimau-dahan (Felis macrocelis).

It is about 3 ft. long, with a tail of 2½ ft. more, and 16 in. high at the shoulders; the head comparatively small, ears

short and rounded, body cylindrical, limbs very robust, tail very full and long, and fur thick and soft; it is ashy or brownish gray, with irregular spots and bands of velvety blackness arranged longitudinally and unbroken along the back; border of mouth black, and feet gray. It is a native of Sumatra, and lives much on trees, hence called tree tiger; the food consists of birds and the smaller deer; it is not very common, and not dangerous.—The animal commonly called tiger cat by the furriers has been described under SERVAL. Other tiger cats are *F. minuta* and *F. Diardi*, both inhabiting the islands of the Malay archipelago, and *F. Nepalensis*, inhabiting the Himalaya mountains.

**TIGER FLOWER,** a species of *tigridia*, both names referring (from Lat. *tigris*, a tiger) to the spotted flowers. It is a Mexican genus of bulb-bearing plants, belonging to the iris family; the long sword-like leaves are much plaited, and the stems, about 2 ft. high, produce a succession of large and very showy but ephemeral flowers. The flowers, 5 or 6 in. across, have three very large outer divisions with a concave base, and together form a cup; the three inner divisions are smaller and fiddle-shaped. The species in cultivation are *T. pavonia*, having rich scarlet flowers variegated with bright yellow and spotted with black, and *T. conchiflora*, orange and yellow with black spots; there are garden varieties of both, differing in the depth of color and markings. Their cultivation is very simple; the bulbs are planted in any good garden soil after cold rains are over, and taken up at the first frosts, dried, and kept until spring where mice cannot destroy them.

Tiger Flower (Tigridia pavonia).

**TIGER MOTH.** See MOTH.

**TIGHE, Mary** (BLACKFORD), an Irish authoress, born in Dublin in 1773, died at Woodstock, Kilkenny co., March 24, 1810. She married in 1793 her cousin, Henry Tighe, of county Wicklow, a member of the Irish parliament, and in 1805 printed for private circulation her "Psyche," a poem founded on the story of Cupid and Psyche as related in the "Golden Ass" of Apuleius. It reached a fifth edition in 1816. She died of consumption after several years of suffering. In 1811 appeared a complete edition of her poetical works, containing many devotional pieces.

**TIGLATH-PILESER.** See ASSYRIA.

**TIGRANES THE GREAT,** a king of Armenia, ascended the throne about 96 B. C., died about 55. He was a descendant of Artaces, the reputed founder of the Armenian monarchy, and by wars during the early part of his reign united all Armenia under his rule, and conquered in addition several provinces. He also acquired by his war with Parthia two important provinces, which comprised the whole of northern Mesopotamia and the tract east of the Middle Tigris, including Assyria proper and Arbelitis; and by some unknown means he obtained possession also of Media Atropatene. In 83 he was invited into Syria by the inhabitants, who were wearied with the continual strife between the princes of the house of the Seleucidæ, and he established himself as king over Cilicia, Syria, and most of Phœnicia, residing at Nisibis. About 80 he made the strongly fortified city of Tigranocerta, between the Tigris and Lake Van, his capital. His support of Mithridates of Pontus, his father-in-law, involved him in a war with the Romans. Lucullus gained several victories over them, and captured Tigranocerta. Pompey, his successor, made an alliance with Phraates III. of Parthia, who engaged Tigranes in war on his own frontier, while Pompey marched into Pontus. The occasion for it was offered by the eldest son of Tigranes, of the same name, who had engaged in a conspiracy against the life of his father, and being discovered had fled to Phraates, who readily embraced his cause and marched an army into Armenia. Tigranes fled, Artaxata was invested, and the Parthian monarch withdrew, leaving the young Tigranes as many troops as he thought necessary to press the siege to a successful issue. When Phraates was gone, Tigranes returned, defeated his son, and drove him out of his kingdom. But soon afterward he was forced to submit to Pompey, who in the mean time had defeated Mithridates also. (See MITHRIDATES.) Tigranes went to the camp of Pompey, and placed himself as a suppliant at the feet of that general. Pompey would not accept the diadem which he offered him, and treated him in a friendly manner, placing him on the throne of Armenia proper. At first Pompey destined the province of Gordyene for the younger Tigranes, but that prince offending him, he made it over to Ariobarzanes of Cappadocia. As the province gave rise to disputes between Tigranes and Phraates, Pompey sent Afranius to drive the Parthians out of it, and gave it to the Armenians. In 64 Tigranes was again at war with the king of Parthia, but the differences between them were composed by the intervention of Pompey. After this he disappears almost entirely from history. He was succeeded by his son Artavasdes or Ardavast.

**TIGRÉ,** a state of Abyssinia, between lat. 12° and 16° N., and lon. 37° 25′ and 40° E. It is an elevated plain, which forms the basis of

several mountain ranges and lofty groups, and is drained in the north by the Mareb and in the south by the Tacazze. The plateau itself varies from 3,500 to 9,000 ft. in elevation, and is deeply indented by the ravines which form the beds of the principal rivers. The Tacazze is second only to the Bahr el-Azrek in size among the rivers of Abyssinia. Tigré is divided into many petty chieftaincies or districts; the principal towns are Antalo, formerly the capital, Axum, and Adowa, the present capital. Adowa, the largest town, is the entrepot of trade on the great caravan route between Massowah and Gondar, and has considerable manufactures.—Tigré was for many years an independent kingdom, but in 1855 was conquered by Theodore, king of Abyssinia, who made it a province of his empire. (See Abyssinia.)

**TIGRIS,** the second river of western Asia, rises in N. W. Kurdistan, S. of Göljik lake, flows S. S. E. to Diarbekir, thence S. E. to Mosul, and thence S. by E. to its junction with the Euphrates at Korna, where the two form the Shat el-Arab. At its source it is less than 10 m. from the Murad or E. branch of the Euphrates; at Mosul it is about 160 m. distant from the sister stream; near Bagdad it is within 20 m. of it, but near Serut the distance has increased to 100 m. Its total course is estimated at 1,150 m., and its width from Mosul to Bagdad, a distance of about 220 m. in a straight line, averages 200 yards; its current in March flows $4\frac{1}{4}$ m. an hour. The greatest height is attained in the latter part of May, and it resumes its usual level by the middle of June. It is navigable in the flood time between Diarbekir and Mosul for rafts; below Mosul it is navigable for steamers at all seasons. The Tigris is swifter and in the latter part of its course deeper than the Euphrates, and its volume is generally greater. It has been calculated that the quantity of water discharged every second by the Tigris at Bagdad is 164,103 cubic feet. In its upper course it receives from the mountains W. of Lake Van the Bitlis-tchai or Eastern Tigris, which surpasses it in volume of water. From the Zagros mountains it receives streamlets which often swell into large rivers. The principal of these are the Upper Zab, the Lower Zab, the Adhem, and the Diyalah. The western affluents are insignificant. The course of the branch streams constantly varies, and some of the tributaries are left dry within a few years of the time that they have been navigable. While the low banks of the Euphrates often cause that river to leave its channel, the Tigris, which runs in a deep bed, seldom varies. (See Euphrates.)—In antiquity the Tigris was the great river of Assyria, and the eastern boundary of Mesopotamia, and on its banks flourished the cities of Nineveh, Seleucia, and Ctesiphon. The name Tigris is supposed to be derived from the old Persian *tigra*, arrow; its Aramaic name was Digla or Diglath, and the Hebrew Hiddekel.

**TILBURG,** a town of the Netherlands, in the province of North Brabant, on the Ley, 14 m. E. S. E. of Breda; pop. in 1873, 24,345. It has a Protestant and several Catholic churches, and a royal castle. The king owns most of the real estate. It is the principal seat of the Dutch manufactories of wool.

**TILDEN, Samuel Jones,** an American lawyer, born in New Lebanon, Columbia co., N. Y., Feb. 9, 1814. He entered Yale college in 1833, but completed his course at the university of New York, and was admitted to the bar. He was a member of the state constitutional convention of 1846, and also of assembly, and did much to shape the canal policy of the state. In 1855 he was defeated as democratic candidate for the office of attorney general of the state. In 1866 he was chosen chairman of the state democratic committee, and in 1867 was a member of the constitutional convention. In 1869–'70 he was active in the organization of the bar association. In 1870–'71 he was prominent in detecting important frauds in the government of New York city, and in 1872 was a member of assembly. In November, 1874, he was elected governor of New York by 50,317 majority. He has been counsel in many important cases, prominent among which are the Flagg contested election for the comptrollership of New York city in 1855; the Burdell heirs against Mrs. Cunningham in 1857; the Cumberland coal case in 1858; and the Delaware and Hudson canal company against the Pennsylvania coal company in 1863.

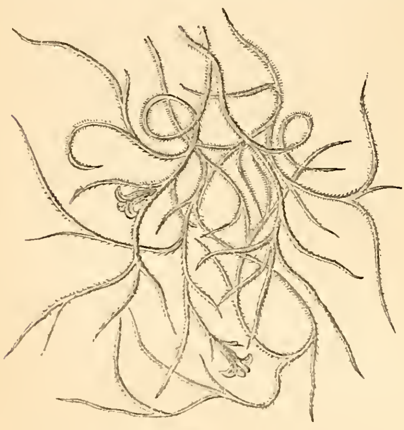
**TILE,** a plate of baked clay, flat, curved, or hollow, used for covering the floors, roofs, or walls of buildings, and for drains and other purposes. The Assyrians employed them as tablets, writing upon them with a style before baking them. (See Cuneiform Inscriptions.) The Egyptians used tiles for the same purpose, but wrote upon them with ink. They also used tiles for roofing, usually in the form of part of a cylinder, one row being laid with the concave side and the next with the convex side upward, the edge being received in the concavity of its fellow. The Greeks used large flat roofing tiles, sometimes having flanges, with semi-cylindrical ones laid over their lines of junction. The flat tiles were sometimes stamped with brief inscriptions, and the others were ornamented with painted devices. They also used tiles in the construction of tombs and the flues of baths, and for drains. The Romans used them still more generally, and their name *tegulæ* (from *tegere*, to cover) came to be applied to bricks, which were much more used than tiles. The real distinction between them is the greater fineness of the tile. The roofing tiles were, like those of the Greeks, large and flat, having flanges rising a little more than two inches above the surface, the junction of the flanges being covered by the arched tile or *imbrex*. It was customary to stamp the tiles with inscriptions designating the pottery, the manufacturer, the name of

the estate which supplied the clay, the name of the reigning emperor or of the consulship, and other matters. Thus they have often served as records of important historical events. The tiles used by the Romans for covering interior walls were large thin squares of terra cotta, generally ornamented on one side with incised devices. The tessellated pavements were formed of small cubical tiles called *tessellæ* (the diminutive of *tesseræ*, from the Gr. *τέσσαρες*, four, having reference to their form). Some of these *tessellæ* were not more than one fourth of an inch square, and they were laid to form mosaics. The Romans, like the more ancient nations, made use of large flat tiles in the construction of their graves, and also for gravestones with inscriptions.—At the international exhibition at Vienna in 1873 there was a rich assemblage of decorative tiles of several countries, many of the specimens being from Great Britain, where the art is now practised in great perfection. Among the latter were Roman tiles and *tessellæ* from mosaic pavements recently excavated at Chichester. There were also glazed decorated tiles (see Encaustic) from Egypt and Assyria, and Saracenic tiles from Spain; also antique tiles from India and from the mosques of Samarcand of the 14th and 15th centuries. In the Indian tiles, brought by Dr. Leitner from Lahore, and taken from old monuments, the colors retained their original vividness. The manufacture in Great Britain dates from mediæval times, doubtless due to imitation of the Roman pottery, and may be divided into two periods. The most ancient tiles were probably made between 1290 and 1380, and those of the second period during the prevalence of the perpendicular style of building. Numerous kilns have been found in the Malvern hills, and it is supposed that Tewkesbury abbey and Worcester and Gloucester cathedrals were furnished by them with tiles. The manufacture is said to have continued in Worcestershire to about 1640. Some of the earliest specimens of tiles in the British museum are from the ruined churches in Norfolk. The designs upon the tiles at that time were chiefly sacred symbols and inscriptions, heraldic devices, and monograms. The material is ordinary coarse red clay, the designs being formed of a lighter-colored clay contained in incisions in the body, and afterward covered with a glazing.—The manufacture of tiles in Holland commenced at a very early period, and in the 18th century large quantities were exported to England for fireplaces. They were also brought to America in the 17th and 18th centuries for fireplaces, hearths, and roofs. Many of them were highly ornamented with various designs. The discovery of transferring designs by printing from paper to earthenware about 1752 created numerous imitations in England, and the demand in that country was in a great measure supplied by home-printed tiles.—What are called dry tiles are made in Great Britain by Prosser's method. The material is dried and reduced to powder in a mill, when it is placed on slabs of plaster of Paris slightly moistened. It is then passed through fine sieves and subjected to intense pressure in steel boxes, from which the tiles are taken to a hot room and dried for a week or two and then ornamented, glazed, and fired. Drain tiles may be made of ordinary brick clay by various simple machines, moved either by power or hand, usually the latter, as the process is very simple. They are all made upon the principle of forcing the prepared clay through a cylindrical or semi-cylindrical tube over a mandrel. Some of them work the material after it has been passed through a pug mill, while others consist of a pug mill and tile machine combined. The uncombined machines cost from $100 to $200, and are capable of turning out by man power from 200 to 300 two-inch tiles per hour, or with one horse about 5,000 large tiles per day. The subsoil where drainage is desirable often contains clay of a suitable quality for their manufacture, and the machines are then taken out upon or near the fields to be drained. (See Drainage, and "Farm Drainage," by Henry F. French, New York, 1865.)

**TILLAMOOK,** a N. W. county of Oregon, bordering on the Pacific ocean, bounded E. by the Coast mountains, and watered by several streams; area, 1,400 sq. m.; pop. in 1870, 408. Tillamook bay affords a good harbor. The coast and rivers abound in fish. The greater portion of the surface is covered with gigantic forests of spruce; there are some small and fertile valleys and hills that afford pasturage. Coal and iron are found. The chief productions in 1870 were 2,899 bushels of wheat, 2,719 of oats, 9,340 of potatoes, 29,340 lbs. of butter, and 764 tons of hay. The value of live stock was $24,285. Capital, Tillamook.

**TILLANDSIA,** a genus of endogenous plants of the *Bromeliaceæ* or pineapple family, the characters of which are given under Pineapple. It was named in honor of Prof. Tillands, a Swedish botanist. The species are numerous in tropical and extra-tropical America, and are mostly epiphytes, with their foliage covered with scurfy scales; some South American species have very handsome white, blue, pink, or purple flowers, and are cultivated as stove plants, either on blocks of wood, in the manner of some orchids, or in baskets or pots of moss. There are eight species in the United States, most of which are confined to Florida, and from growing upon the trunks and branches of trees they are popularly called air plants. The largest Florida species is *T. utriculata*, with a large tuft of leaves about 2 ft. long, which are narrow and recurved at the apex, but are much dilated and concave at the base to form a cup which contains a considerable quantity of water. (See Pitcher Plants.) Other species have this peculiarity, there being one in Brazil, the water held in the cups of which is the only locality for an aquatic spe-

cies of *utricularia* or bladderwort. The flowers of *T. utriculata* are pale blue, on much branched stems longer than the leaves. Others have very narrow leaves, and are only a few inches high. The most important species, unlike the rest, has slender, thread-like, pendent stems; this is *T. usneoides*, so called from its resemblance in manner of growth to *usnea*, a genus of long pendulous lichens, and is popularly known as long moss, and also as black or Spanish moss; its northern limit is the Dismal swamp in Virginia, and it is found all through the southern states to Texas, and in South America to Chili, as well as in the West Indies. Its much branching stems, 2 ft. or more long, bear recurved leaves 2 to 3 in. long, which are scarcely broader than the stems, and like those are greenish gray; each internode or space in the stem between two leaves is twisted to form a loose spiral of about two



Long or Spanish Moss (Tillandsia usneoides).

turns; the flowers, produced at the ends of short branches, are about a fourth of an inch across, and have three bright yellowish green petals; the pod, about an inch long, contains numerous slender seeds, with a long hairy tuft. This epiphyte, draping the trees and swinging in the wind, frequently forms a characteristic feature of the southern landscape, though where very abundant its effect, on account of its sombre color, is not altogether pleasing; recently considerable quantities in the living state have been sold in northern cities for the decoration of rooms; it will flourish in an ordinary greenhouse if hung up in any convenient place. The central portion, or the woody part of the stem, is scarcely larger than a horse hair, which it much resembles also in toughness and elasticity; it is dark brown or black even in the fresh plant. This material is used where it grows for various purposes, and is an article of commerce. The rude method of preparing the moss is to place it in shallow water until the outer covering becomes loosened; after it is thoroughly dried, it is beaten until nothing is left but the horsehair-like central portion; of late years the process has been much facilitated by the use of steam; the moss is placed in large tight vats, steamed, and dried, and afterward beaten by machinery, the product being superior to that prepared in the slow way. In the southern states it is twisted into ropes, and woven into horse collars, saddle blankets, and mats of various kinds, and is a common filling for beds; northern upholsterers use it by itself or with hair for stuffing chairs, sofas, and mattresses.

**TILLEMONT, Louis Sébastien le Nain de,** a French historian, born in Paris, Nov. 30, 1637, died Jan. 10, 1698. He was educated at Port Royal, and at the episcopal seminary of Beauvais, became a subdeacon in 1672, and a priest in 1676. In 1677 he went to reside with the recluses at Port Royal; and in 1679 he retired to his estate of Tillemont, between Vincennes and Montreuil. His principal works are: *Mémoires pour servir à l'histoire ecclésiastique des six premiers siècles* (16 vols. 4to, 1693–1712), and *Histoire des empereurs et des autres princes qui ont régné durant les six premiers siècles de l'église* (6 vols. 4to, 1690–1738). His *Vie de St. Louis* was first published by the French historical society (6 vols. 8vo, 1847–'51).

**TILLODONTIA,** a new order of eocene mammals, described by Prof. O. C. Marsh in 1875, apparently combining characters of the plantigrade carnivora, ungulates, and rodents. The typical genus *tillotherium* in its skeleton comes nearest to the bears, but has a dentition partly ungulate and partly rodent.

**TILLOTSON, John,** an English prelate, born at Sowerby, near Halifax, in 1630, died in London, Nov. 22, 1694. His father was a strict Calvinist. At an early age Tillotson became a student at Cambridge, where he was made a fellow in 1651, and remained till 1657, when he became tutor in the family of Prideaux, Cromwell's attorney general. Chillingworth's writings having converted him from Puritanism, at 30 years of age he took orders in the English church, and was successively curate of Cheshunt, rector of Keddington, and preacher at Lincoln's Inn in London. He opposed the proclamation of Charles II. for liberty of conscience, which made him unpopular at court, preached earnestly against popery, and advocated the exclusion of the duke of York. He was the leading member of the commission of 20 divines appointed in 1689 to examine and revise the liturgy. On the accession of William III. he became dean of St. Paul's, and in 1691 archbishop of Canterbury. His marriage with a niece of Cromwell brought him into intimate connection with Wilkins, bishop of Chester, whose posthumous works he edited. His life was written by Dr. Thomas Birch (8vo, London, 1752). He published "The Rule of Faith" (1666) and several volumes of sermons. For the copyright of his manuscript sermons his widow received 2,500 guineas; and many collective editions afterward appeared in 14

and 12 vols. 8vo. His complete works were published in 1707–'12, in 3 vols. fol. (10 vols. 8vo, 1820). A volume of his sermons was translated into French by Barbeyrac, and six volumes into German by Mosheim.

**TILLY, Johann Tserclaes**, count, a German soldier, born in the castle of Tilly, Brabant, in February, 1559, died in Ingolstadt, April 20 (O. S.), 1632. He was educated at a college of Jesuits, first served in the Spanish army in the Netherlands, and in Hungary distinguished himself against the Turks. In 1610 Duke Maximilian of Bavaria appointed him field marshal. On the opening of the thirty years' war he was placed at the head of the army of the Catholic league, and contributed to the victory of Prague, Nov. 8, 1620; in 1621 he drove Count Mansfeld, the stanchest supporter of the Protestant cause, from Bohemia and the Upper Palatinate; in 1622 defeated the margrave of Baden at Wimpfen on the Neckar, and Christian of Brunswick at Höchst; and in 1623 routed the latter once more at Stadtloo. When Christian IV. of Denmark joined the German Protestants, he signally defeated him at Lutter in August, 1626. He next besieged Nordheim, which he took after a hard struggle, crossed the Elbe, and coöperated with Wallenstein in conquering the continental part of Denmark. In 1630 he succeeded Wallenstein as chief commander of the imperial armies. On May 10, 1631, he carried Magdeburg by storm, and allowed his soldiers to burn most of the town and massacre about 25,000 persons. But in the same year (Sept. 7) he was utterly defeated by Gustavus Adolphus at Breitenfeld, near Leipsic, and vainly tried to recover his prestige. He was mortally wounded in an engagement with Gustavus at the river Lech near Rain, April 5, 1632. He declined the title of count of the empire and the principality of Kalenberg, was a devoted Catholic, and boasted of his temperance and chastity.—See Klopp's *Tilly im dreissigjährigen Kriege* (2 vols., Stuttgart, 1861).

**TILSIT**, a town of the kingdom and province of Prussia, at the junction of the Tilse and the Niemen (Memel), which is here spanned by a long bridge, 60 m. N. E. of Königsberg; pop. in 1871, 20,236. The town proper consists of two long streets, and has many fine new buildings, manufactories of paper, machinery, iron, sugar, and leather, and an active trade in grain. After Napoleon's victory at Friedland, he met here for the first time the emperor Alexander (June 25, 1807) on a raft in the middle of the Niemen, and the Tilsit treaty of peace, by which Prussia lost half her possessions, was concluded early in July. (See Bonaparte, vol. iii., p. 42.)

**TILTON, Theodore**, an American author, born in New York, Oct. 2, 1835. He studied at the New York free academy, and in 1856 became a writer for the "Independent," of which he was editor for many years. In 1871 he became editor of the Brooklyn "Union," and in 1872 founded the "Golden Age," which he edited till 1874. In that year he sued the Rev. Henry Ward Beecher on a charge of seducing his wife, but the trial, lasting six months, resulted in a disagreement of the jury. He is also a public lecturer, and has published "The American Board and Slavery" (1860); a "Memorial of Mrs. Browning," prefixed to an edition of her last poems (1862); "The Fly" (1865); "Golden-Haired Gertrude" (1865); "The Two Hungry Kittens" (1865); "The King's Ring" (1866); "The True Church" (1867); "The Sexton's Tale, and Other Poems" (1867); "Sanctum Sanctorum, or Proof-Sheets from an Editor's Table" (1871); "Tempest-Tossed," a novel (1875); and several pamphlets, including a life of Victoria C. Woodhull.

**TIMBER.** See Wood.

**TIMBS, John**, an English author, born in London, Aug. 17, 1801, died there in March, 1875. In 1821 he became amanuensis to Sir Richard Phillips, publisher of the "Monthly Magazine," to which he contributed "A Picturesque Promenade round Dorking" in 1822. In 1825–'6 he published anonymously a selection of ethical passages, under the title "Laconics." From 1827 to 1838 he was editor of the "Mirror," one of the earliest popular low-priced weeklies. He edited the "Literary World" in 1839–'40, and was one of the editors of the "Illustrated London News" from 1842 to 1858. He compiled "The Arcana of Science and Art" (11 vols., 1828–'38); "Knowledge for the People" (4 vols., 1831–'2); "Year Book of Facts in Science and Art" (31 vols., 1839–'69); and "The Illustrated Year Book" (2 vols., 1850–'51). Among his other publications are: "Things not generally Known" (7 vols., 1856–'67); "School Days of Eminent Men" (1858); "Stories of Inventors" (1859); "Lives of Wits and Humorists" (2 vols., 1862); "English Eccentrics and Eccentricities" (2 vols., 1866); "Nooks and Corners of English Life" (1866); "Wonderful Inventions" (1867); "Notable Things of our Own Time" (1868); "Ancestral Stories and Traditions" (1869); "Abbeys, Castles, and Ancient Halls of England and Wales" (2 vols., 1870); "Notabilia" (1872); and numerous other works.

**TIMBUCTOO**, a town of central Africa, on the borders of the Sahara, about 9 m. from the river Niger, about lat. 17° 40′ N., lon. 3° W.; pop. about 13,000, greatly increased during the season of trade, from November to January. It is nearly triangular and about 3 m. in circuit. It was formerly surrounded by a clay wall, but this was destroyed in 1826. The houses are closely packed together, and mostly built of clay and stone; some of them are two stories high, and show considerable taste in their decoration. The port of Timbuctoo is at Kabara on the Niger, which has a vast artificial basin, but is accessible for only four or five months in the year, the stream at other times being too shallow for navigation. The most valuable traffic is by caravans, for which

Timbuctoo is the central station of northern Africa. Gold dust is the great article of trade, but many native products and foreign manufactures are also found here. The merchants of Timbuctoo are generally only agents of those at Mogadore, Morocco, Fez, and other places in northern Africa; and this, with the incessant conflicts of race and religion, prevents the accumulation of wealth. The inhabitants are a mixed population of indigenous negroes, Tuariks, Bambarras, Mandingos, Arabs, and Foolahs, the governing race. The city dates from the 12th century, but it was long known in Europe only by reports of native travellers, until it was first reached by Major Laing in 1826, and furtively visited by Caillié in 1828. In 1853–'4 Dr. Barth resided there nearly a year.

**TIMOLEON**, a Corinthian general, liberator of Syracuse, born about 395 B. C., died in 337. He was early noted for his patriotism and courage, and in his hatred of tyranny he brought about the assassination of his brother Timophanes, who had usurped power in Corinth. Seized by remorse, he lived for nearly 20 years in utter seclusion. In 344 he took command of an expedition sent out by the Corinthians in aid of the Syracusans. After gaining a victory over Hicetas, tyrant of Leontini, who had formed an alliance with the Carthaginians against Dionysius the Younger, he obtained the support of several Sicilian cities. He marched to Syracuse, and took possession of the island of Ortygia, surrendered to him by Dionysius, who sailed for Corinth. Timoleon retired to Adranum, while Neon, in command of Ortygia, attacked the blockading force of the Carthaginians. These soon began to distrust Hicetas, and suddenly sailed away with their whole fleet and all their troops. Timoleon came at the head of 4,000 men, and took the portion of Syracuse held by Hicetas without the loss of a single man. He gave the inhabitants a democratic constitution, ordered the fortifications to be demolished, and erected courts of justice on their site. In a short time more than 60,000 immigrants and exiles repeopled the deserted town. But in 339 the Carthaginians landed at Lilybæum an army of 80,000 men led by Hasdrubal and Hamilcar. The inhabitants were panic-struck, and with difficulty Timoleon collected 12,000 men and set out for the western portion of the island, where he attacked the enemy just as they were crossing the Cremissus, and, aided by a storm, completely routed them. He soon after overthrew Hicetas and Mamercus, tyrant of Catana, and proceeded in his work of dethroning tyrants until none was left throughout Grecian Sicily. Timoleon declined the supreme power, and withdrew again from public life, residing with his family in Syracuse, in a house voted to him by the inhabitants. Toward the close of his life he became totally blind. When he died, the Syracusan people voted to honor him for all future time with festival matches in music, races, and gymnastics. His life was written by Cornelius Nepos and Plutarch.

**TIMON**, called The Misanthrope, an Athenian who lived in the latter part of the 5th century B. C. In consequence of disappointments in friends, he secluded himself, and admitted no one to his society except Alcibiades. He is said to have died from a broken limb which he refused to have set. He is the subject of Shakespeare's "Timon of Athens."

**TIMOR**, an island of the Indian archipelago, between Flores and Timor-Laut, extending N. E. and S. W. nearly 300 m., with a general breadth of about 50 m.; area, about 11,500 sq. m.; pop. about 200,000. It lies between lat. 9° 30′ and 11° 40′ S., and lon. 123° 20′ and 127° 10′ E. The native chiefs on the W. and S. coasts acknowledge the supremacy of the Dutch, who have their principal settlement at Kupang or Coepang; while those in the E. and N. parts pay tribute to the Portuguese, who have established themselves at Dilli. The coasts are but slightly indented, but the harbors of Kupang and Dilli are safe and commodious. The shores are lined in many places by rocks and sand banks; and several islets intervene between Timor and the island of Flores to the west and Timor-Laut to the east, which are respectively distant about 100 and 250 m. The island is traversed throughout its length by a mountain chain, which attains a height in the north of about 6,000 ft. There are no active volcanoes, nor are there any igneous rocks of recent origin; but Timor peak, near the centre of the island, is a volcanic cone which has been quiescent since 1638. Numerous offsets extend from the main range to the coasts on both sides, so that the surface is almost entirely occupied by mountains separated by narrow valleys, though there are considerable tracts of level ground. The rivers are short mountain torrents; many of them become dry in summer, and the water is unwholesome. The mountains are generally bare and rocky, and there are no forests in the proper sense of the word. The indigenous vegetation is described by Wallace as poor and monotonous. It consists largely of eucalypti, acacias, and sandal wood, with grass scanty on the uplands, and coarse but luxuriant in the moister districts. Rice grows abundantly in the lowlands, and wheat and coffee thrive on the higher slopes and plains. Gold, copper, and iron have been found in small quantities. The animals on the N. W. side of the central range of mountains resemble those on the western islands of the archipelago, but those on the opposite side are strongly allied to the fauna of Australia, which is about 360 m. distant. Besides 15 species of bats, but seven mammals are met with in Timor; these are the common Indo-Malayan monkey, a civet cat, a tiger cat, a species of deer, a wild pig, a shrew mouse, and an opossum. There are 118 species of birds. The common domestic animals of Europe have all been introduced. Fish are plentiful on the coasts;

pearl oysters are found in some places, and a kind of coral much prized by the Japanese is procured on the reefs. The people are of low stature, with very dark complexions and bushy hair, and resemble the Papuan type of mankind. The women weave cloth, and the only manufactures which the men engage in are the construction of canoes, and ornaments for their horses. A considerable trade is carried on, principally from Kupang, and is chiefly in the hands of the Chinese.—Timor was visited by Dampier in 1699. The region about Dilli has been occupied by the Portuguese about 300 years, but the settlement is miserably governed, poorly cultivated, and without roads. The Dutch colony is little better. The natives throughout the island are peaceably disposed toward Europeans, but belligerent among themselves, and practically independent.

**TIMOTHEUS,** an Athenian general, died in Chalcis in 354 B. C. He was the son of the general Conon and a pupil of Isocrates. He was made a general in 378, and in 375 defeated a Spartan fleet near Alyzia. In consequence of his failure to come promptly to the relief of Corcyra, thereby endangering the loss of the island, he had to lay down his generalship and answer the charges brought against him. Though acquitted, he went in 372 to Asia, and entered the service of the king of Persia; but he returned to Athens and was sent on an expedition in support of Ariobarzanes, satrap of Phrygia. Seizing a favorable opportunity, he took possession of Samos for the Athenians, and secured for them a partial control of the Hellespont and the occupation of a large surrounding territory. Timotheus was then appointed to a command including Macedonia, Thrace, and the Chersonese. With the aid of Macedonia he reduced Torone, Potidæa, Pydna, Methone, and various other cities belonging to the Olynthian confederacy, but was unsuccessful in the attack upon Amphipolis. In 363–362 he proceeded against Cotys, king of Thrace, and to the defence of the Athenian possessions in the Chersonese, in which he is said to have been successful; but for some reason not now known he retired from his command. In 358 the cities of Eubœa sent messages to Athens entreating aid against the Thebans, who had despatched a large force into the island. Through the energy of Timotheus, within five days an Athenian fleet and army under his command were in Eubœa, and in the course of 30 days the Thebans were forced to evacuate the island under capitulation. In 356, the second year of the social war, Chares, Iphicrates and his son Menestheus, and Timotheus were appointed to the joint command of an Athenian fleet. In 354 Chares accused his colleagues of having been the direct cause of his defeat at Chios, and Timotheus and Iphicrates were recalled and accused of treason. Iphicrates was acquitted, but Timotheus was found guilty and fined 100 talents. He retired to Chalcis in Eubœa, where he died in the same year. His son Conon was permitted to compromise the fine by paying 10 talents for repairing the walls of the city.

**TIMOTHY** (Gr. Τιμόθεος, "he who honors God"), a disciple of Paul, and his companion in travel and in preaching. He was a native of Derbe or Lystra in Lycaonia, and the son of a Greek and a Jewess. To prevent the cavils of the Jews, Paul circumcised him. He was set apart to the office of the ministry by the laying on of the hands of Paul and the presbytery. He journeyed through Macedonia and Achaia, and was afterward sent by Paul to Ephesus, whence he accompanied the apostle to Jerusalem, and probably to Rome. In the epistles of Paul written during his captivity at Rome, Timothy is mentioned as being with the apostle. Tradition says that Timothy was the first bishop of Ephesus, and was martyred under Domitian.

**TIMOTHY, Epistles to,** two canonical books of the New Testament, addressed, according to ecclesiastical tradition, by the apostle Paul to his disciple Timothy. They are mentioned by Tertullian, Clement of Alexandria, and Origen. Schleiermacher attacked the authenticity of the first epistle, and after him the authenticity of either the first or both epistles has been doubted by Baur, Reuterdahl (archbishop of Upsal), Meyer, De Wette, Ewald, and others; against whom it has been defended by Thiersch, Wieseler, Reuss, Huther, Bleek, and others. The defenders of their authenticity are not agreed as to the times when the epistles were written. Most of them suppose the first to have been written about the year 65. The second, according to the same writers, was written during the captivity of Paul at Rome, and while he was in expectation of martyrdom. It gives instructions on Christian steadfastness and fidelity (ch. i.); exhorts Timothy to constancy (ch. ii.); warns him against false teachers, invites him to come to Rome, and gives information of many of the companions of Paul (ch. iii. and iv.). The two epistles to Timothy, together with the one to Titus, are comprised under the name pastoral epistles. Among the recent commentaries on them are those of Wiesinger (1850), Ellicott (London, 3d ed., 1864), Huther (3d ed., 1866), and Oosterzee in Lange's *Bibelwerk* (2d ed., 1864; English translation by Washburne and Harwood, New York, 1868).

**TIMOTHY GRASS,** an agricultural grass (*phleum pratense*), which takes this name from Timothy Hansen, who cultivated it extensively in Maryland, and brought it into notice. In some parts of the country it is called Herd's grass, a name which leads to confusion, as the red-top (*agrostis vulgaris*) is called Herd's grass in Pennsylvania and some other states; in England it is known as cat's-tail. The genus *phleum* has its one-flowered spikelets in dense spikes; its structure is illustrated under GRASSES. A native species, *P. alpinum*, is found on the higher mountains, but *P. pra-*

*tense* is supposed to have been introduced from Europe, where it is found from the Mediterranean to the arctic regions. It was first cultivated for hay in this country, and the seeds were taken to England as a novelty about 100 years ago; but it is much less esteemed there than with us. Timothy is a perennial, with a rather coarse stem, which in dry soils thickens at the base and becomes bulbous; its average height is 2 to 3 ft., but it sometimes grows to 5 or even 7 ft. It forms the great bulk of the hay crop of the country, and is sown to the neglect of other grasses which are much better suited to some soils. Analysis shows, in 100 parts of timothy hay, 9·7 of albuminoids, 48·8 of carbohydrates, 3 of fat, and 22·7 of crude fibre.

Timothy Grass (Phleum pratense).

**TIMOUR,** or **Tamerlane** (a corruption of Timour Lenk, *i. e.*, Timour the Lame), an Asiatic conqueror, born at Sebz, a suburb of Kesh, about 40 m. S. E. of Samarcand, April 9, 1336, died at Otrar on the Jaxartes, Feb. 18, 1405. He was the son of the chief of the Turkish tribe of Berlas, which inhabited Kesh, and claimed to be on his mother's side a direct descendant of Genghis Khan. In 1361 he became chief of his tribe, and supported the cause of Hussein, khan of northern Khorasan; and after driving out the Calmucks of the khan of Kashgar he married Hussein's sister. With him he had frequent contentions, and after the death of his wife in 1365 a war broke out between them, which ended in the defeat and death of Hussein, and the taking of Balkh, his capital, in 1369, after a siege of three years. Soon after a general Mongol assembly was held, and Timour was proclaimed khan of Jagatai (Transoxiana), Samarcand being chosen as his residence. He now aspired to the dominion of all the countries once under the power of Genghis Khan, and attacked the neighboring princes in detail. The khan of the Getes, ruling the country between the Jaxartes and the Irtish, was forced to render homage, and in 1379 the khan of Khiva was conquered. He then undertook the reduction of Khorasan (1380), and received the submission of a part of it, but was met with a fierce resistance by Gaiyath ed-Din Pir Ali, whose capital was Herat. His efforts were all in vain, and the taking of his capital by storm led to the conquest of the remainder of the country. All Khorasan was now in Timour's power; but the town of Sebsewar revolted and was stormed, and thousands of its inhabitants were subjected to a cruel death. Timour now aspired to the conquest of the world. All Persia was soon in his power; the country between the Tigris and the Euphrates, from the sources to the mouths of those rivers, submitted to his authority; and the Christian princes of Georgia also became his tributaries. An invasion of Timour's territory by Tokhtamish, whom he himself had established in the Mongol empire of the north, led to the conquest of Kiptchak. The pursuit of his enemy having led the conqueror of the East into the provinces of Russia, he threatened Moscow, marched to the south, and sacked and burned Azov, at the mouth of the Don. In 1398 he crossed the Indus at the passage of Attok, and, after a long march, in which he massacred 100,000 captives, stood before Delhi, which soon capitulated. He penetrated still further into the country, but was recalled by the news of insurrections in Georgia and adjoining parts, and of the designs of Bajazet, sultan of Turkey. His first care was to crush the rebellion in Georgia, and as the Mongol and Ottoman conquests now bordered upon one another, a collision was soon rendered certain. Timour overran Syria, then a dependency of Egypt, and then stormed the revolted city of Bagdad, July 9, 1401, leaving in the public places of the town a pile of 90,000 slaughtered human beings. At last the two great armies of the sultan and the Mongol conqueror met on July 20, 1402, on the plains of Angora, and the former was totally defeated and captured. (See BAJAZET.) Timour's dominions now covered all Asia from the Irtish and Volga to the Persian gulf, and from the Ganges to Damascus and the archipelago. He made Solyman, a son of Bajazet, ruler of European Turkey, and his brother Musa of Turkey in Asia. The sultan of Egypt also became his vassal. He now retired to Samarcand (July, 1404), and spent two months in festivities, but did not long remain idle. He had planned an invasion of China, from which the house of Genghis had recently been expelled, and previous to his return from his Ottoman conquests had sent an army beyond the Jaxartes to prepare the way for his own advance. At the head of 200,000 veteran troops he began his march, crossed the Jaxartes on the ice, and had gone 300 miles from his capital when he died. His army was disbanded, and the invasion of China was given up. He died after a reign of 35 years, all of which was spent in military operations, and left 36 sons and grandsons and 17 granddaughters. A large proportion of his conquests, especially in the northern and western parts of Asia, were lost immediately by his successors. The glory of his race was revived in his descendant Baber, the conqueror of India.—The great authority for the life of Tamerlane is the Persian history of Sheref ed-Din Ali, to whom the journals of his secretaries were intrusted, and whose work has been translated into French by Pétis de la Croix,

under the title of *Histoire de Timur-Bec, connu sous le nom du grand Tamerlan* (4 vols. 12mo, Paris, 1722). The writings attributed to Timour have been preserved in Persian, and are of questionable authenticity. The work on the "Institutions" of his government, with an English translation and a valuable index, was published at Oxford in 1783 (4to) by Major Davy and White, the professor of Arabic, and has also been translated from the Persian into French by Langlès. The autobiographical "Commentaries" of Timour have been translated from a manuscript of Major Davy by Major Stewart, and published by the oriental translation committee of London. These only contain his life from his birth to his 41st year, no version having as yet appeared of the remaining portions. See also the translation of the narrative of Clavijo, envoy of Henry III. of Castile to Timour, by C. R. Markham (Hakluyt society, 1860), and Lamartine, *Les grands hommes de l'Orient* (Paris, 1865).

**TIMROD, Henry,** an American poet, born in Charleston, S. C., Dec. 8, 1829, died in Columbia, Oct. 6, 1867. He was educated at the university of Georgia, but took no degree, and studied law. During the first years of the civil war he wrote martial lyrics, and early in 1863 joined the confederate army of the west as correspondent of the Charleston "Mercury." In January, 1864, he became editor of the Columbia "South Carolinian," which was discontinued in February, 1865, and revived in Charleston in 1866. He was for a time assistant secretary to Gov. Orr. He published "Poems" (Boston, 1860; enlarged ed. with a memoir by Paul H. Hayne, New York, 1873).

**TIMUQUANS,** a tribe of Indians in Florida, belonging to the Choctaw family, formerly occupying the coast above St. Augustine. The Franciscans established missions among them in 1592, and though these were checked by the massacre of several of the missionaries by the heathen party in 1597, they were revived and continued till the destruction of the missions and mission Indians by Carolina and Georgia in the border wars. Several works for the use of the Timuquan missions and a grammar, chiefly by Father Francis Pareja, a Mexican, were printed in the 17th century; and petitions signed by the chiefs in 1688 show that they had all been educated to some extent. Near the close of the century Dickenson found the missions in a thriving condition and acting as post houses on the route to the English colonies.

**TIN** (Ger. *Zinn;* Fr. *étain*), an almost silvery white, highly lustrous, non-elastic metal; chemical symbol, Sn (Lat. *stannum*, tin); equivalent, 116; sp. gr. 7·29. It is softer than gold and harder than lead; malleable at ordinary temperatures into thin laminæ (tin foil); so ductile at 212° F. that it can be drawn into fine, very flexible wire, which however breaks under a weight of less than one ton per square inch of section; so brittle at 392° F. as to be broken by a blow or fall; not appreciably affected in density by hammering; fusible at 442° F.; burns in air at high temperature, with white light; volatile at very high temperature; comparatively indifferent to air or moisture at ordinary temperatures; a good conductor of heat and electricity. Melted tin has a strong tendency to crystallize on cooling; and the surface of cast tin, when etched with dilute acid, shows its crystalline texture in figures analogous to the tracery of frost on window panes (*moiré métallique*). The free crystals are monometric, or, when obtained by the electric current, quadratic prisms, showing dimorphism of the metal. A bar of tin crackles when bent (the tin cry, *cri d'étain*, *Zinngeschrei*), and under rapidly repeated flexures the bent place grows hotter than the hand can bear. Both noise and heat are due to the friction of the interior crystal faces upon each other. The handling of tin communicates a peculiar odor to the skin. There are three oxides of tin: the stannous, $SnO$, stannoso-stannic, $Sn_2O_3$, and stannic, $SnO_2$. A certain obscure modification of the last, the hydrate of which is insoluble in nitric or muriatic acid, is called metastannic oxide. The stannic and metastannic oxides form salts with alkalies, earths, and metallic oxides. Muriatic acid dissolves tin as stannous chloride, $SnCl$, which is used by dyers and in laboratories as a reducing agent, by virtue of its strong affinity for oxygen and chlorine. Dilute sulphuric acid scarcely attacks tin; heating with concentrated sulphuric acid transforms it to stannous sulphate, setting free sulphurous acid; very dilute nitric acid dissolves it cold, without any escape of gas, ammonia being formed simultaneously with the stannous nitrate and held as nitrate of ammonia in the solution. Concentrated nitric acid attacks tin violently, forming the insoluble metastannic oxide, which is the "putty powder" used in enamelling and in polishing plate. *Aqua regia* dissolves tin as stannic chloride, $SnCl_2$. Alkalies cause oxidation of tin, forming stannic acid, which unites with the alkaline bases. Thus, tin being heated in concentrated caustic soda solution, hydrogen is set free, and sodic stannate is formed. This is extensively used as a mordant, the basis of the "tin-prepared liquor" of dyers and calico printers. Sulphuretted hydrogen does not attack massive tin at ordinary temperatures. There are three sulphides of tin, of which the stannous or protosulphide may be obtained by heating sulphur and tin together; the second, sesquisulphide, by heating the first with additional sulphur; and the third, bisulphide, by a similar process. In the last case, the high temperature, which would otherwise decompose the bisulphide, must be kept down by adding to the ingredients volatile substances (mercury, sal ammoniac), which in escaping will absorb heat. This sulphide, thus produced, presents delicate golden or brownish yellow scales, and is used as a bronze powder

(mosaic gold, the *aurum musivum* or *mosaicum* of the alchemists). A mixture of stannous and stannic chloride, added to gold chloride in solution, precipitates a purple powder, supposed to be stannic oxide, colored by metallic gold in fine particles, or a mixture or combination of the oxides of gold and tin. It is known as the purple of Cassius, and is used for coloring porcelain and glass, with which it is incorporated by fusion. The amalgam of tin and its alloys with lead and other metals is employed in the arts. (See AMALGAM, BRITANNIA METAL, BRONZE, MIRROR, PEWTER, and SPECULUM.)—*History.* Tin ore, being a heavy mineral, not altered by ordinary meteoric agencies, may occur in alluvial and diluvial deposits, like gold and precious stones; and being also, when pure, easily reduced by smelting, its treatment might naturally become known to nations of great antiquity. It is often said that the Hebrews, Egyptians, and Greeks employed this metal; but so far as the question turns upon the Hebrew *bedil* (Ezek. xxvii. 12; Numb. xxxi. 22; Isa. i. 25, &c.) and the Greek κασσίτερος, which have been translated as tin, this seems doubtful. Tin was certainly often confounded with lead, being called by the Romans *plumbum candidum.* Even the *stannum* of Pliny was not tin; and not until the 4th century does *stannum* definitely bear this meaning. (See Kopp's *Geschichte der Chemie.*) But bronze vessels found at Thebes are said to be in part composed of tin, which Wilkinson suggests the Egyptians may have obtained from Spain or India long before the Phœnicians voyaged in the Atlantic. The latter people brought κασσίτερος from the Cassiterides, supposed to have been the Scilly islands, off the coast of Britain. This may have been brought to the Scilly islands from Cornwall, or else, it is presumed, the Phœnicians pretended to visit these islands, and gave them a deceptive name, in order to mislead the Romans and conceal their real trade on the Cornish coast. (See "Transactions of the Geological Society of Cornwall," vols. iii. and iv.) Spain also is believed to have furnished tin to the Phœnicians. In the middle ages Cornish tin was used for church bells, and later for bronze cannon. The ancient Mexicans obtained tin from the mines of Tasco, and with it made bronze for very hard cutting tools; and they used small T-shaped pieces of tin for money. Cortes had bronze cannon made with the tin of Tasco.—*Distribution.* Native metallic tin is one of the rarest of minerals. It has been reported from Siberia, Bolivia (doubtful), and Pennsylvania. (See Genth's recent volume on the mineralogy of that state.) There is a native sulphide (stannine, tin pyrites), but the only ore commercially utilized is the stannic oxide, called tinstone or stannite, $SnO_2$; sp. gr. 6·94; crystalline form, tetragonal pyramids; percentage of tin, 78·38; crystals yellowish and translucent when pure, but usually dark brown, almost black, from admixture of ferric and manganic oxide. This occurs in veins, beds, and *Stockwerke*, or in secondary (alluvial and diluvial) deposits. In the former case, it is found in quartzose crystalline rocks (granite, gneiss, porphyry, mica and hornblende schists, quartz-porphyry, &c.), associated with arsenical pyrites, iron and copper pyrites, bismuth, zinc blende, wolfram, molybdenite, specular iron, &c., and with such earthy minerals as feldspar, tourmaline, chlorite, topaz, apatite, fluor spar, and scheelite. The leading localities where such deposits have been worked are Cornwall and the Saxon and Bohemian Erzgebirge. Tin veins also occur in Brittany, Finland, Spain, Mexico, Bolivia, and New South Wales. The placer deposits are illustrated at the islands of Banca and Billiton in the Malay peninsula, and at some other points in the East Indies. The tin placers of Australia have also furnished of late large quantities of tin ore; and such deposits (stream tin) occur subordinately in Cornwall, Brittany, Spain, and elsewhere. A remarkable deposit of tin ore in a dike of trachyte is said to exist in Durango, Mexico. Stannite occurs with cryolite in Greenland. Tin ore in veins, dikes, or beds of dark porphyry is found in San Bernardino county, southern California; specimens are said to have been found in Idaho, in the bed of a stream; and several localities in the Appalachian regions are known to mineralogists as furnishing the ore in occasional crystals or in thin veins. Chesterfield and Goshen, Mass., and Lyme and Jackson, N. H., are localities of stannite; and tin has been detected in the magnetic iron ore of the highlands of New York and New Jersey, and in some of the auriferous ores of Virginia. The tin-ore deposits of Missouri, the object of a considerable speculative excitement a few years ago, seem to consist in the replacement to a minute extent, in certain crystalline schists, of titanic by stannic acid, the two being isomorphous. The relative importance of the chief tin-producing regions is shown by the following estimates of production in tons:

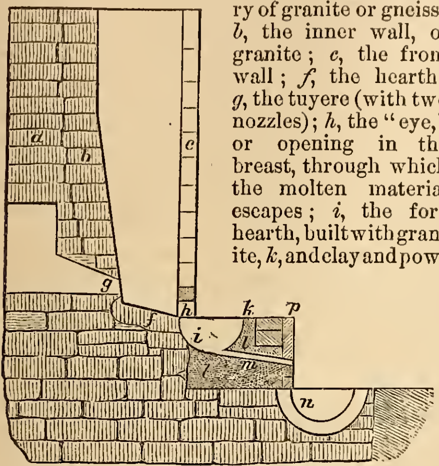
| REGIONS OF PRODUCTION. | 1872. | 1873. | 1874. |
|---|---|---|---|
| United Kingdom | 9,560 | 9,970 | 10,000 |
| Banca | 3.203 | 4.355 | 4.049 |
| Billiton | 2.946 | 2,980 | 3,157 |
| Malacca | 9,785 | 6.963 | 7,149 |
| Australia | 150 | 2,990 | 5,800 |

The amount credited to Great Britain includes the tin produced in that country from imported Australian ores. The product of Bolivia or Upper Peru, known as Peruvian tin, was estimated in 1868 by English authorities at 1,500 tons; but it is probably much less at present, since no account is taken of it in the trade reports. Saxony and Bohemia produce an insignificant quantity, not more than 200 or 300 tons in all; and Spain yields still less.—In the tin mines of Cornwall the ore occurs in small

strata, veins, or masses ("tin floors"); in congeries of small veins; in large veins; and disseminated in alluvial deposits. The congeries or networks of small veins (*Stockwerke* of the Germans) occur in granite and "elvan" (feldspathic porphyry). The large metalliferous veins are grouped in three districts: the S. W. part of Cornwall, beyond Truro; the neighborhood of St. Austell; and the neighborhood of Dartmouth, in Devonshire. The first is the richest and best explored. The tin veins belong to different systems, having nearly the same general course, but differing in dip. It was formerly thought that tin occurred in the upper portions of the lodes only, and the appearance of copper pyrites in depth was considered to be a sign that the tin ore had been "cut out;" but more recently tin ore has been found at great depths and below the copper. Thus the Dolcoath mine was worked first as a tin mine for a very long period; then as a copper mine for half a century; and finally again, at still greater depth, and with considerable profit, as a tin mine. Alluvial tin ore or stream tin deposits occur on the hillsides and in the valleys, and furnished for centuries the whole of the Cornish tin. The largest works of this kind are around St. Just and St. Austell. Many of the Cornish mines have been unprofitable since 1872, on account of the great fall in prices resulting from the influx of Australian ore and metal. The mines in the East Indies might perhaps have brought about this revulsion still earlier, since they were capable of producing tin very cheaply; but the supply from that source was limited at the will of the governmental authorities, so as to divide the market with Cornwall, on terms which left some profit to the Cornish mines. One authority estimates the product in 1868 at 7,200 tons for Great Britain, and 7,500 tons for southern Asia and India. According to a recent writer (*Berg- und Hüttenmannische Zeitung*, 1875), the total product of tin in the world about 1870 was something over 11,000 tons annually, of which 6,000 tons came from Cornwall and 4,000 tons from Asia. (This estimate for Asia is apparently too low.) But since that time, and especially since 1872, a very extraordinary development of tin mining in Australia has revolutionized the market.—The Australian tin-ore deposits thus far known occur in the region of the Cordilleras, in Victoria, New South Wales, and Queensland. In Victoria the older outcropping rocks are predominantly Silurian, and tin ore is found in small quantity in alluvial deposits, but hitherto not in veins. In New South Wales and Queensland there is a greater quantity and variety of exposed rock formations, and among them granites, porphyries, and metamorphic schists, with which the tin ore is associated. In a portion of New South Wales it appears connected with more recent eruptive rocks. The alternations of rain and drought in the seasons are a serious inconvenience to alluvial mining, which suffers also, like the placer mining of gold in Australia and the United States, from occasional excessively dry years. The existence of tin ore in this region was made known by the Rev. W. B. Clarke, colonial geologist, in 1845; in 1869 a shepherd brought to market a considerable quantity which he had obtained by washing, without knowing its value; a population of 10,000 miners was attracted to the district, and a feverish speculation raged until near the end of 1871, followed by disastrous reaction and a gradual renewal of industry in a more reasonable way. Up to the end of 1871 the production had been about 2,000 tons of tin. The present export in metal and in ore (sent to England for reduction) is said to exceed 7,000 tons of tin; the number of workmen is between 2,000 and 3,000. Veins are abundant, but the entire product is at present derived from alluvial mines. These occur in five principal districts, interspersed with scattered minor districts, the aggregate area being about 1,000 sq. m., the greater part of which lies south of the boundary between Queensland and New South Wales. The placers usually lie along present or former watercourses, and present at the surface granitic sand and pebbles, with underlying gravel, and at the bottom, resting upon the bed rock, a layer of clay, gravel, and bowlders, in which occur tin ore, wolfram, tourmaline, quartz, and occasionally sapphire and ruby. Sometimes the series is repeated, giving two layers of stanniferous gravel, of which the lowest rests upon the rock, a phenomenon familiar to placer miners for gold; and the methods of working are similar to those of the latter. The total depth of the deposit is rarely less than 4 or more than 20 ft. The labor employed is partly Chinese; the average cost of the ore, delivered at the nearest harbor, is perhaps £40 a ton, though rich mines, favorably located, can deliver it at £30. Some furnaces have been erected near the mines to smelt the ore; but wood, the only fuel available there, though cheap at present, is likely to be rapidly exhausted. Two large establishments, at Sydney and Brisbane, have successfully smelted the Australian tin ores with coal in reverberatory furnaces. The metal, however, even after refining, contains but 99 per cent. of tin, on account of the wolfram invariably present in the ore. For this reason Australian ore is disliked by the smelters of Cornwall, and Australian tin always commands a somewhat lower price than Banca or Cornish metal. New and extensive discoveries of tin ore have been recently reported in Tasmania.—The tin ore of the island of Banca, in the Dutch East Indies, occurs as stream tin and also in veins in granite. The Dutch government at present works the alluvial deposits only. These consist of 9 to 30 ft. in depth of loam, red and blue clay, coarse and fine sand, and tin ore. The tin-bearing layer is from 3 to 22 in. thick, in some cases even more. The mines are worked du-

ring the dry season of eight months, the rainy season being devoted to smelting the ore. The workings are open pits and cuts; and the material is conveyed away to be washed, water being collected by means of dams and reservoirs. After the washing the ore is calcined, leached in water (to remove sulphates of iron and copper), smelted in shaft furnaces with charcoal, drawn into a purifying receptacle, and poled. The resulting tin is the best in the market. The government furnishes engineers, superintendents, and furnaces; all the rest is supplied by the workmen (Chinese), who receive about $5 09 for each 100 lbs. of cast tin. The "Straits" tin comes from the British settlement of Malacca, and from various points on the Malay peninsula and the islands between it and Java. Drought and troubles with the Malays have temporarily reduced the supply from this source. Its quality varies according to the locality of the mines and the skill of the metallurgical treatment; but it is usually less pure than Banca tin. —*Metallurgy of Tin.* The tin ore found in drift or alluvium is usually purer than that in veins, because the arsenides, sulphides, and metallic salts are decomposed and carried away by the action of water. The veinstuff as mined is usually rock or gangue containing disseminated ore (sometimes as little as ⅛ of 1 per cent. of tin), and requires a careful preliminary concentration, the difficulty of which is enhanced by the presence of heavy minerals (wolfram, bismuth, &c.), which must be removed to secure a pure metal as the result of smelting. Connected with the mechanical concentration there is usually a calcination, to convert heavy sulphides into oxides, which can be more easily washed away. The apparatus of concentration comprises launders, plane tables, buddles, percussion tables, jigs, &c. (See METALLURGY.) The theory of the reduction of tin ore is simple. The stannic oxide must be deprived of its oxygen by contact with carbon at high temperature, and reduced to metallic form in fusion, while the earths and metallic oxides accompanying it must be collected in the slag. In practice the operation is embarrassed by several difficulties. One of these arises from the high temperature necessary for the reduction of the stannic oxide, at which temperature other metallic oxides, which should pass into the slag, are also partially reduced and enter the metallic bath, or cause "salamanders" or "scaffolds" by chilling in the furnace. Hence the necessity of removing lead, bismuth, copper, antimony, arsenic, zinc, iron, tungsten, molybdenum, &c., as far as practicable, before smelting. There is also danger that the stannic oxide, which plays the part of an acid toward many bases, and of a base toward acids, may pass partly into the slag as ferrous or calcic stannate, or stannic silicate. The oxidability and volatility of tin are also sources of loss, to avoid which the shaft furnace is so constructed as to remove the metal, once reduced, as soon as practicable from the influence of the heat and blast. The earthy ingredients of the ore, in which usually silica predominates, tend to form "stiff" (not easily fusible) slags; and, rather than add fluxes to counteract this evil, at the cost of an increase of the amount of zinc carried into the slag, it is common to smelt with little or no extra flux, producing a scarcely fused slag, in which more tin is mechanically caught and retained than is chemically combined with silica or the bases. This slag may be remelted or treated by mechanical concentration, to extract the tin which it contains, in fine metallic grains. Wolfram, which cannot be completely washed out, either with or without preliminary roasting, and which if present in the smelting charge goes partly into the slag and partly as tungsten into the metallic tin, is sometimes removed by a preliminary smelting of the ore with sodic carbonate or sulphate (Glauber's salt), by which a soluble tungstate of soda is formed, which can be leached out. Muriatic acid will leach out from roasted tin ore the chlorides of iron, copper, and bismuth.—The melting of the concentrated and purified tin ore may take place in a reverberatory or in a cupola furnace. The former is advantageously employed where coal is cheap and good. It loses less tin by oxidation than the shaft furnace, in which the blast acts more or less on the tin, and it requires less fuel for the production of a given amount of tin. Zirkel says the reverberatory consumes for each part of tin produced 1¾ part of coal and loses 5 per cent. of tin, while the shaft furnace consumes 3 parts of coal and loses 15 per cent. of tin. But when the ore is impure, the reverberatory furnishes an inferior tin. The greater product is due to the better opportunity afforded for the grains of tin to settle from the slag into the bath, which in the shaft furnace must be quickly removed to prevent oxidation from the blast. But this oxidizing blast, on the other hand, removes more completely arsenic, bismuth, &c. The principal ingredients added in the reverberatory are reducing agents (carbon), and sometimes, to counteract predominant silica in the ore, small quantities of slacked lime and fluor spar. This furnace is used in England, and also in Australia. In the cupola furnace, which is employed on the continent of Europe and in the Indies, the additions, aside from the fuel, are chiefly stanniferous slags and residues from the same process, which serve to prevent the fine dressed ore from packing too closely in the furnace to permit the passage of the blast. The cupola furnaces are made comparatively small in section, and contracted near the tuyeres, in order to secure the necessary temperature; and to prevent the reduction of iron oxides, they are made low (in Saxony, 1·88 to 2·82 metres; in Banca, 1·26 to 2·82 metres). The hearth slopes at the bottom from the rear wall toward the breast, and the fused material, flowing down this slope, passes con-

tinually under the front wall and into a receptacle before it, cut in stone and lined with clay and charcoal powder. Here the metal separates and settles, away from the influence of the blast. Such a shaft furnace (Saxon) is shown in the accompanying section, in which *a* is the rough masonry of granite or gneiss; *b*, the inner wall, of granite; *c*, the front wall; *f*, the hearth; *g*, the tuyere (with two nozzles); *h*, the "eye," or opening in the breast, through which the molten material escapes; *i*, the fore hearth, built with granite, *k*, and clay and pow-



Saxon Shaft Furnace.

dered charcoal, *l*; *m*, the tapping duct, ending in an opening in the iron front plate *p*; *n*, the crucible or refining pot. The arrangements for removing the slag from *i*, and the chambers for saving dust and fumes, placed above the furnace, are not shown in the diagram. The dimensions of the furnace here shown are, in metres: height, 2·83; width at top 0·96, at bottom, front, 0·58, and rear, 0·48; depth from front to rear wall at top 0·62, at bottom 0·48; inclination of hearth, 26°; size of "eye," 0·10 high by 0·38 at top and 0·5 at bottom; depth of fore hearth 0·38, of crucible 0·4; diameter of each, 0·5. The product of the shaft or reverberatory furnace contains more or less of the impurities of the ore. Of iron there are at least traces in all sorts of tin; 0·5 per cent. injures the silvery color and lustre, and 1 per cent. diminishes perceptibly the softness and smoothness. Of copper, 1 to 1·5 per cent. makes tin harder and less malleable; and as the proportion is increased, the metal becomes more brittle and suffers a change in lustre. Of antimony and bismuth, 0·5 per cent., without affecting the lustre, causes a brittle, crystalline structure. Of lead, 1 per cent. injures color and lustre, and softens the tin. Arsenic to the amount of 0·5 per cent. affects color and lustre; over 1 per cent. of it renders the tin lighter, and gives it a spotted, dull, or darkened appearance. Wolfram and molybdenum in considerable proportions diminish rather the fusibility than the strength or lustre; zinc renders the metal harder, more brittle, and whiter; sulphur makes it "short;" tin oxide reduces its brilliancy; quicksilver, contained in several varieties of East Indian tin, renders it crumbly, and hinders its union with other metals. The refining of crude tin is conducted in England as follows: The blocks of tin are set on the hearth of a reverberatory, and liquated at low temperature, by which process a purer tin is obtained in a kettle, while an alloy consisting mainly of less fusible metals (iron, wolfram, copper, &c.) remains on the hearth. The liquid tin in the kettle is further purified by "poling;" that is, green wood or damp coal is submerged in it, causing by the generation of gases a violent ebullition, which continually changes the surface of the bath exposed to the air, and promotes the oxidation of the foreign substances. These are skimmed off, and the bath is allowed to settle, when there is a further deposit of heavy metals (iron, copper, &c.) on the bottom. After settling, the tin is drawn off in three portions, the upper layer being refined block tin, the middle common tin, and the lowest an impure alloy which is again liquated. Block tin is cast in moulds of marble. The purest metal (containing only 0·01 per cent. of iron) is called grain tin, and is produced by heating the best block tin until it is brittle, and dropping it from a considerable height upon flat stones. The German process of refining consists in pouring the melted crude tin from a certain height upon an inclined cast-iron plate, coated with loam and covered with a layer of glowing coal about 0·25 metre thick. The less fusible impurities remain among the coals, and the purified tin flows along the plate, to be collected in a sump of cast iron filled with coal. The operation is performed repeatedly; the coals are subsequently beaten, to remove adhering grains of tin, and the residue is returned to the smelting furnace. Care must be taken to cast tin at the right temperature. If too hot, it becomes iridescent and "red-short;" if too cold, it assumes a dull appearance, becomes "cold-short," and loses ductility. The proper moment for casting is shown by a mirror-like clearness of the surface of the bath. A special refining of tin in the humid way consists in dissolving the granulated metal in muriatic acid, and precipitation by zinc. The zinc solution is subsequently decomposed with milk of lime, and the precipitate manufactured by heating into zinc white.—The following analyses are from Kerl's *Metallhütten-kunde* (Leipsic, 1873):

| CONSTITUENTS. | 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. |
|---|---|---|---|---|---|---|---|---|---|
| Sn.... | 99·961 | 99·9 | 99·76 | 98·64 | 93·50 | 95·66 | 99·9 | 99·594 | 98·18 |
| Fe.... | 0·019 | 0·2 | trace | trace | 0·07 | 0·07 | .... | trace | trace |
| Pb.... | 0·014 | .... | .... | 0·20 | 2·76 | 1·93 | .... | ...... | .... |
| Cu.... | 0·006 | .... | 0·24 | 0·16 | .... | .... | .... | 0·406 | 1·60 |
| As.... | ...... | trace | .... | .... | .... | .... | .... | trace | trace |
| Sb.... | ...... | .... | .... | .... | 3·76 | 2·34 | .... | ...... | .... |
| Bi.... | ...... | .... | .... | .... | .... | .... | 0·1 | ...... | .... |

1, 2. Banca. 3, 4. English. 5, 6. Peruvian (Bolivian). 7. Saxon, from ore treated with muriatic acid. 8. Bohemian, refined. 9. Bohemian roll tin, third class.

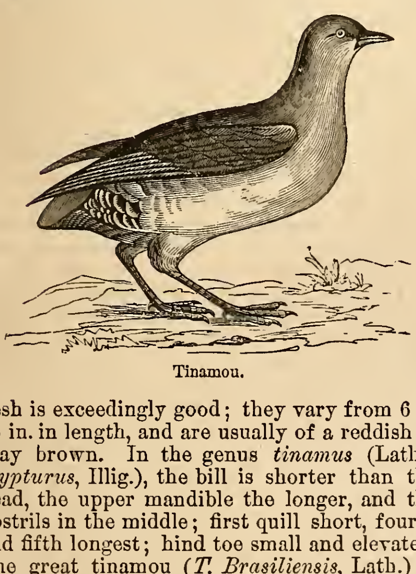
—*Uses of Tin.* Tin foil is used for coating the backs of mirrors, wrapping articles requiring to be kept from the air, lining boxes, covering Leyden flasks, &c. The latter uses require less copper in the composition, and the material is sometimes called stanniol. Of the following four analyses by Stötzel, the first two are of foil for large mirrors, the third for small mirrors, and the fourth for wrappers and linings:

| CONSTITUENTS. | 1. | 2. | 3. | 4. |
|---|---|---|---|---|
| Tin | 97·6 | 97·8 | 98·47 | 96·21 |
| Copper | 2·16 | 1·23 | 0·38 | 0·95 |
| Lead | 0·04 | 0·76 | 0·84 | 2·41 |
| Iron | 0·11 | 0·10 | 0·12 | 0·09 |
| Nickel | .... | .... | .... | 0·30 |

Tin foil is prepared by rolling cast tin into plates, and beating and doubling as with gold foil, though by a simpler process. (See GOLDBEATING). Tin foil consisting of a surface of tin, with an interior of lead or tin-lead alloy, is prepared by placing a plate of lead or alloy in a mould slightly larger, casting tin around it, and rolling and hammering. Tin-lined lead pipe for plumbers' use is made by setting a core of block tin in the centre of a mass of melted lead, so that the more fusible tin is melted, but does not mix with the remainder of the bath, and then proceeding as in the ordinary manufacture of lead pipe. (See LEAD, vol. x., p. 262.) Tin plating is performed either by covering the metallic articles to be plated with melted tin, or by humid processes. The former method is chiefly confined to copper, iron, and zinc. Copper may be heated, cleaned with sal ammoniac, sprinkled with resin to prevent oxidation, and then plated by pouring melted tin upon it, and spreading the tin with tow, a high temperature being maintained. The plating of sheet iron, to form so-called "tin plate" or sheet tin, for domestic utensils, &c., is conducted as follows: The thin sheets of iron are cleaned by immersion in dilute sulphuric acid and subsequent rubbing with sand and water and washing, after which they are annealed by exposure to cherry heat for 12 hours in cast-iron boxes, tightly closed and luted. Imperfect or seriously oxidized plates are rejected. The accepted ones, which are purplish from a thin external film of oxide, are polished by being passed cold through rolls, then subjected to a second and less prolonged annealing, then sorted and cleansed again, and finally taken to the tinning apparatus. After cleansing they will quickly rust on exposure to air, but may be kept indefinitely without injury if immersed in pure water. The tinning apparatus comprises a series of long rectangular pots or tanks, with a fire under each. These tanks contain the liquid baths into which the plates are to be plunged. The operation comprises a series of immersions: first into melted grease, in which the plates are left till all moisture has evaporated; then successively into several baths of tin, each of which is purer than the preceding, so that the sheets acquire a coating first of alloy and finally of pure tin; then into melted grease again, in which the superfluous tin runs off, while the liquid grease prevents a too rapid cooling and consequent cracking of the surface. As the tin in the final tin bath becomes fouled by alloyed iron, it is removed to the preceding tin bath, and from this in turn to the first bath. After the final grease bath (tallow and palm oil), which anneals the plates, the edging of tin which usually forms around them is removed by dipping into melted cast iron, which melts it, so that a quick blow on the plate causes it to drop off. The plates are at last rubbed with bran and then with sheepskin to remove grease and dirt, sorted, packed in boxes, and marked to indicate size and quality. The sheet iron for tin plates is rolled from the best charcoal or coke bar. Terne plates have, instead of tin, a coating of tin-lead alloy, containing from one third to two thirds lead. Iron may be coated with zinc first, and then very readily tinned by dipping into the fused metal, since tin and zinc unite with ease. Sheet zinc is tinned in the same way, but should not be left in the bath so long as to become alloyed with tin beyond the surface. Lead and its alloys may be tinned in like manner. The process above given for tinning iron is not applicable to cast iron, unless it has been decarbonized on the surface by heating in iron oxide, after the manner of the "annealing" practised in the manufacture of malleable castings. The humid methods of plating tin upon various metals are numerous. Pins, which are made of brass wire, and other objects of brass or copper, are dipped into an aqueous solution, containing 1 part argal, 2 parts alum, and 2 parts salt, in which tin has been dissolved, or to which stannous chloride has been added. In this liquid they remain unaffected until brought into contact with metallic tin, whereby an electro-chemical action is caused, and all the objects connected directly or through one another with the metallic tin are immediately coated with tin reduced and precipitated from the solution. Boiling brass or copper objects, in contact with tin filings, in a solution of stannic oxide in caustic potash, is also an excellent way. Iron objects (nails, hooks and eyes, &c.) may be tinned, after suitable cleansing, in a bath of argal and stannous chloride, with the addition of zinc filings; or the bath may be composed of equal parts of the tin salt and common salt, dissolved in water, or of 1 part tin salt, ¼ part sal ammoniac, and 1 part common salt, dissolved in 2 parts nitric and 4 parts muriatic acid, diluted with water. In the latter liquid most metallic objects may be tinned by sufficiently prolonged immersion, copper or iron being kept in contact with a zinc wire during the process. Zinc is most easily tinned. For galvanic tinning a weak battery may be employed, and a solution of stannic chloride in caustic potash. But the use of the battery in this and similar opera-

tions on a commercial scale will doubtless be superseded by the modern magneto-electric machines, which furnish the necessary current by mechanical instead of chemical means; or, to speak more accurately, by the combustion of coal, a cheap fuel, instead of the combustion of zinc or other expensive substances.

**TINAMOU**, a name applied to the *tinamidæ*, a family of gallinaceous birds peculiar to South America. The bill is moderate, rather straight, flattened, the base covered by a membrane, and the tip suddenly hooked; wings short and concave; tail short or wanting; tarsi rather long, scaled in front, and without spurs; toes long, with stout blunt claws, the hind one sometimes wanting. They live in the fields on the borders of woods, are low and heavy fliers, but rapid runners, and feed on grains, fruits, and insects; they lay about a dozen eggs, on the ground in tufts of grass, and the young when hatched soon disperse; when pursued they endeavor to hide in the bushes, and are often caught by a noose on the end of a stick; their



Tinamou.

flesh is exceedingly good; they vary from 6 to 18 in. in length, and are usually of a reddish or gray brown. In the genus *tinamus* (Lath.; *crypturus*, Illig.), the bill is shorter than the head, the upper mandible the longer, and the nostrils in the middle; first quill short, fourth and fifth longest; hind toe small and elevated. The great tinamou (*T. Brasiliensis*, Lath.) is about 15 in. long, of a deep olive color, slightly and narrowly banded with black, with crown red and secondaries red and black; pale reddish ash below; it is found in Guiana and Brazil, resembling in size, habits, colors, and quality of flesh the partridges of the old world; though gentle and timid, it is said not to be capable of domestication. The males have a trembling plaintive whistle to warn of danger or attract the females; they live in couples during breeding time, at other seasons in small flocks. The nest is made on the ground in a slight hollow, covered with dry grasses; they lay twice a year; the young follow the parent as soon as hatched. Other genera are *rhynchotus* (Spix), with the species *R. rufescens* (Wagl.) or rufescent tinamou, inhabiting the borders of lakes and the swampy thickets of Paraguay in small troops; and *tinamotis* (Vig.), with three or four species, found in high desert places, some distance from fresh water.

**TINCTURE**, a solution of a vegetable, animal, or in some cases mineral substance in alcohol, dilute alcohol, or ether. As tinctures present the active principles of many drugs in a small bulk, and are little liable to change, they are largely used in medicine. They are made by maceration or displacement. The former process consists in soaking the drug for a time which varies greatly in different cases. Displacement or percolation is largely employed in the preparation of fluid extracts as well as of tinctures, and consists in allowing the fluid employed to filter slowly through the powdered drug, the lower layer of fluid, containing a large portion of the soluble constituents, being constantly drawn off and its place supplied by fresh strata from above. This process is in most cases much more rapid than maceration. Tincture of iodine and tincture of the chloride of iron demand no maceration, as iodine dissolves rapidly in alcohol or ether, while the iron preparation is a mere mixture of a solution with alcohol.

**TINDAL, Matthew**, an English author, born at Beer-Ferris, Devonshire, about 1657, died in London, Aug. 16, 1733. He was educated at Oxford, took the degree of bachelor in 1676, and was elected to a fellowship at All Souls, which he retained through life. He was created LL. D. in 1685, and soon after became a Roman Catholic, but returned to the church of England just before the revolution of 1688. After the revolution, of which he was a zealous partisan, he became an advocate, sat as judge in the court of delegates, and received a pension from the crown of £200. In 1706 he published "The Rights of the Christian Church asserted, against the Romish and all other Priests that claim an independent Power over it," in opposition to high church principles. This excited a long controversy, during which he published two defences, which he reprinted in 1709, with essays on obedience and the law of nations, the liberty of the press, and the rights of mankind in matters of religion. In 1710 he attacked the party of Dr. Sacheverell in a pamphlet entitled "New High Church turned Old Presbyterian;" but the house of commons on one day condemned Sacheverell's sermons, and on the next ordered Tindal's "Rights of the Christian Church" and the second edition of his "Defences" to be burned. His most important work is "Christianity as old as the Creation, or the Gospel a Republication of the Religion of Nature" (1730), in which he expressly denies that Christianity contains any truth which the human reason might not have discovered for itself. Waterland, James Foster, Conybeare, Leland, Chapman, and others wrote replies to it. He left a second volume of this, only the preface to which has been published.

**TINDALE, William.** See TYNDALE.

**TINGHAI.** See CHUSAN.

**TINNÉ,** the northern branch of the great Athabascan family of American Indians, being the most northerly of all except the Esquimaux. They live north of lat. 55°, and extend from central Alaska to Hudson bay. They embrace several large divisions, differing in language: 1, the Chippewyans or Pointed Skins, called Montagnais by the French, including also the Caribou Eaters and Yellow Knives; 2, the Beaver Indians, on the west, the Mauvais Monde, and Sarcees; 3, the Dog Ribs, Slaves, Hares, Nahaunes, Red Knives, Sheep, Brushwood, and Rocky Mountain Indians, all E. of the Rocky mountains; 4, the Tacully or Carriers, including the Sicaunees in British Columbia; 5, the Kutchin Dekedhé or Loucheux; 6, the Kenai, including the Atnas in Alaska. They are generally mild, timid, and honest, live on fish or reindeer and other animals, more frequently snared than hunted, and do not attempt to cultivate the ground. They are tall and slim, with a full face, dark complexion, and piercing eyes, and have more beard than other Indians. Their weapons and implements are generally rude, made of bone or stone; but some tribes make excellent water-tight vessels of roots. Their *jkanzè* or medicine men have great influence. The Chippewyans leave the dead unburied, but the Tacullies burn them. The estimates of their numbers vary; those east of the Rocky mountains are estimated by Archbishop Taché at 15,000. Catholic and Protestant missions have been established among them in various parts.

**TINNE, Alexandrine Petronella Francina,** a Dutch traveller, born at the Hague, Oct. 17, 1835, murdered in Fezzan, Africa, Aug. 1, 1869. Her father was an English merchant, her mother the baroness Van Steengracht-Capellen of Holland. She was rich, travelled in Europe and the East, settled in 1861 in Cairo, and in 1862 set out from Khartoom with a steamboat, transport vessels, beasts of burden, and a large retinue, to visit the White Nile. Her state made the natives believe her the daughter of a sultan. In 1863 she explored the Bahr el-Ghazal, the W. arm of the White Nile, in company with Baron von Heuglin and Dr. Steudner, the latter of whom, together with Miss Tinne's mother, and many others, died from exposure. The expedition, which was absent 14 months, determined astronomically the position of Lake Meshera, one of the feeders of the Ghazal. The flora of the region has since been illustrated in Kotschy's *Plantæ Tinnianæ*, partly from her drawings and descriptions. In 1869 she set out from Tripoli for Bornoo, with 70 camels and 50 attendants, of whom the only Europeans were two Dutch sailors. From Moorzook she turned aside to visit the country of the Tuariks, and while on the way to Ghat was murdered by her attendants.

**TINOCERAS,** or **Titanotherium,** a fossil mammal of the order *dinocerata*, discovered by Prof. O. C. Marsh in the eocene of Wyoming territory, in 1870. It was as large as an elephant, and had many characters of the proboscidians, with three separate pairs of horns, and large decurved canines like the walrus; it also had characters of both the perissodactyl and artiodactyl ungulates. These animals have been named *eobasileus* and *loxolophodon* by Prof. Cope, and *uintatherium* by Prof. Leidy. ("American Naturalist," vol. vii., 1873.)

**TINTORETTO, Il,** an Italian painter, whose real name was GIACOMO ROBUSTI, born in Venice in 1512, died there in 1594. He was the son of a dyer, whence he received his popular name. He studied for a short time under Titian, and subsequently began a rigorous course of self-instruction, inscribing over his studio: *Il disegno di Michel Angelo e'l colorito di Tiziano* ("The drawing of Michel Angelo and the coloring of Titian"). He did not however content himself with following them, but aspired to become the founder of a school, which should supply whatever was deficient in their styles. He soon rose into great reputation among the Venetians, and in his best period his quickness of invention and the facility and rapidity of his execution were unequalled perhaps by any painter; but his impetuosity made his performances remarkably unequal. His portraits are his most uniformly excellent works, and his landscapes are distinguished for imaginative suggestiveness. But his reputation rests mainly upon his great historical pictures in Venice. His masterpieces are the two immense compositions representing St. Mark rescuing a tortured slave from the hands of the heathen, and the "Crucifixion," both painted in his best period. The doge's palace is rich in his works, and contains, among other remarkable pieces, a representation of paradise 84½ ft. long and 34 ft. high, painted, like almost everything he produced, in oil. In the latter part of his life he degenerated into a coarse style, of which his "Last Judgment" and "Worshipping of the Golden Calf," in the church of Sta. Maria dell' Orto, are examples. In the maturity of his powers he wrought so fast and at so low a price, that few of the contemporary painters of Venice could get employment. Many of his works were bestowed gratuitously upon convents, and for others he got barely enough to pay for the materials.

**TIOGA. I.** A S. county of New York, bordering on Pennsylvania, and intersected by the North branch of the Susquehanna river and by several railroads; area, 480 sq. m.; pop. in 1875, 31,744. The surface is very hilly and the soil generally fertile. The chief productions in 1870 were 103,955 bushels of wheat, 229,395 of Indian corn, 622,379 of oats, 167,674 of buckwheat, 398,770 of potatoes, 79,432 lbs. of wool, 1,907,767 of butter, and 65,078 tons of hay. There were 6,402 horses, 16,424 milch cows, 9,393 other cattle, 19,668 sheep, and 6,130 swine; 8 manufactories of agricultural implements, 3 of boots and shoes,

17 of carriages and wagons, 1 of machinery, 1 of pianos, 1 of printing paper, 11 flour mills, 12 tanneries, 35 saw mills, and 9 planing mills. Capital, Owego. **II.** A N. county of Pennsylvania, bordering on New York and drained by the Tioga river and its affluents; area, about 1,100 sq. m.; pop. in 1870, 35,097. The surface is hilly and heavily timbered, and the soil better adapted to grazing than tillage. Iron ore is found, and bituminous coal is abundant, of which large quantities are transported to Buffalo by the Corning, Cowanesque, and Antrim, and Tioga railroads. The chief productions in 1870 were 163,719 bushels of wheat, 236,313 of Indian corn, 564,684 of oats, 116,263 of buckwheat, 282,618 of potatoes, 89,788 lbs. of wool, 145,209 of maple sugar, 1,574,825 of butter, 65,889 of cheese, and 82,572 tons of hay. There were 6,148 horses, 16,017 milch cows, 15,149 other cattle, 32,729 sheep, and 8,331 swine; 3 manufactories of agricultural implements, 28 of carriages and wagons, 7 of cheese, 12 of furniture, 2 of glassware, 1 of woollens, 10 flour mills, 13 tanneries, and 46 saw mills. Capital, Wellsborough.

**TIPPAH,** a N. county of Mississippi, bordering on Tennessee, drained by the Hatchie and Tallahatchie rivers and Tippah creek; area, about 500 sq. m.; pop. in 1870, 20,727, of whom 5,091 were colored. The surface is undulating, and the soil fertile. The chief productions in 1870 were 37,429 bushels of wheat, 582,988 of Indian corn, 15,255 of oats, 43,125 of sweet potatoes, 15,457 lbs. of wool, 188,439 of butter, and 6,307 bales of cotton. There were 3,116 horses, 2,010 mules and asses, 13,761 cattle, 9,942 sheep, 32,629 swine, and 9 saw mills. Capital, Ripley.

**TIPPECANOE,** a river of Indiana, which rises in a lake of the same name in Kosciusko co., and flows generally S. W. into the Wabash river 9 m. above Lafayette, Tippecanoe co. Its length is about 200 m. It is famous for the battle fought on its banks, Nov. 7, 1811, in which the Americans under Gen. Harrison defeated the Indians under Tecumseh's brother.

**TIPPECANOE,** a W. county of Indiana, intersected by the Wabash river, drained by the Tippecanoe river and several creeks, and intersected by the Wabash and Erie canal and several railroads; area, 500 sq. m.; pop. in 1870, 33,515. The surface is generally level, and the soil a rich black loam. The chief productions in 1870 were 552,677 bushels of wheat, 909,367 of Indian corn, 177,578 of oats, 94,516 of potatoes, 54,286 lbs. of wool, 267,971 of butter, and 16,654 tons of hay. There were 9,095 horses, 5,836 milch cows, 12,608 other cattle, 16,310 sheep, and 27,293 swine; 4 manufactories of agricultural implements, 6 of boots and shoes, 25 of carriages and wagons, 5 of machinery, 1 of paper, 1 of vegetable oil, 3 of woollens, 14 flour mills, 3 breweries, 1 distillery, 1 planing mill, 6 saw mills, and 1 beef-packing and 3 pork-packing establishments. Capital, Lafayette.

**TIPPERARY,** a S. county of Ireland, in the province of Munster, bordering on the counties of Galway, King's, Queen's, Kilkenny, Waterford, Cork, Limerick, and Clare; area, 1,659 sq. m.; pop. in 1871, 216,210. In the N. part a range of mountains extends completely across from the Shannon to King's county, and there are several groups in other parts of the county, the highest of which does not exceed 2,500 ft. above the sea. The principal rivers are the Shannon, which flows along the W. boundary, and the Suir, which intersects it and partly bounds it on the south. A portion of Lough Derg is in Tipperary. The soil of the level country is a rich loam of great fertility. Butter is largely exported. Coal, copper, lead, and slates are found. It is divided into the North and South ridings, of which the chief towns are Nenagh and Clonmel. The town of Tipperary, on the Arra, an affluent of the Suir, has a large trade in agricultural produce; pop. in 1871, 5,638. Carrick-on-Suir and Cashel are also in the county.

**TIPPOO SULTAN,** or **Tippoo Sahib,** the last independent sovereign of Mysore, born in 1749, killed at Seringapatam, May 4, 1799. He was the son of Hyder Ali, and was first known by the appellation of Feth Ali Khan. He distinguished himself in the war against the English, and succeeded his father, Dec. 7, 1782. He at once gave a new impulse to the war, took Bednore and other cities, and concluded a peace, March 11, 1784, on advantageous terms. He then assumed the titles of sultan and padishah, and subdued the Nairs of Malabar, carrying off from that province, it is said, 70,000 Christians, and forcing 100,000 Hindoos to become Mohammedans. Under a flimsy pretext, in December, 1789, he broke the treaty with the English by invading the territory of their ally, the rajah of Travancore. The English in turn invaded Mysore, took several of his strongholds, were joined by the Mahrattas and the subahdar of the Deccan, and, under Cornwallis and Abercromby, besieged him in Seringapatam, his capital. In March, 1792, Tippoo was forced to conclude peace, agreeing to pay within a year 33,000,000 rupees, to give up to the allies nearly half of his dominions, and to deliver two of his sons as hostages. The earl of Mornington (afterward Marquis Wellesley), then governor general of India, subsequently discovered that he was engaged in intrigues with the French and making preparations for war, and in February, 1799, on his refusal to desist from arming his subjects, gave orders for the invasion of Mysore. Gens. Stuart and Harris defeated the Mysoreans in two encounters, at Sidasir and Malaveli; and the sultan himself was obliged to take refuge in Seringapatam, at the storming of which by Gen. Baird he was killed.

**TIPTON. I.** A W. county of Tennessee, bordering on the Mississippi river, and bounded N. by the Hatchie; area, 370 sq. m.; pop. in 1870, 14,884, of whom 6,891 were colored. It

has a level surface and fertile soil. Its S. E. corner is intersected by the Louisville and Nashville and Great Southern railroad. The chief productions in 1870 were 30,579 bushels of wheat, 446,771 of Indian corn, 18,681 of oats, 12,104 of Irish and 18,380 of sweet potatoes, 74,777 lbs. of butter, and 10,052 bales of cotton. There were 1,879 horses, 1,851 mules and asses, 2,784 milch cows, 4,315 other cattle, 4,675 sheep, and 20,240 swine. Capital, Covington. **II.** A central county of Indiana, drained by Cicero creek and other streams; area, 280 sq. m.; pop. in 1870, 11,953. The surface is level and the soil fertile. It is intersected by the Indianapolis, Peru, and Chicago, and the Pittsburgh, Cincinnati, and St. Louis railroads. The chief productions in 1870 were 149,822 bushels of wheat, 357,835 of Indian corn, 21,487 of oats, 25,413 of potatoes, 30,648 lbs. of wool, 179,905 of butter, and 4,892 tons of hay. There were 2,967 horses, 2,059 milch cows, 3,691 other cattle, 10,762 sheep, and 11,835 swine; 1 flour mill, 14 saw mills, and 1 woollen factory. Capital, Tipton.

**TIRABOSCHI, Girolamo**, an Italian author, born in Bergamo, Dec. 28, 1731, died in Modena, June 3, 1794. He was educated in the Jesuit college of Monza, became a Jesuit, and about 1766 was appointed professor of rhetoric in the university of Milan. In 1770 he was made librarian of the duke of Modena. His *Storia della letteratura italiana* (13 vols., Modena, 1772–'83; best ed., 16 vols., Milan, 1822–'6) extends from the earliest times to the end of the 17th century. Tiraboschi was also the author of many other literary, historical, and biographical works.

**TIRESIAS**, a Greek soothsayer, born in Thebes, the son of Eueres and Chariclo, and fabled to have lived through nine generations of men, but blind from his seventh year. His loss of sight was ascribed by one account to the fact that he disclosed to mortals what they should not know; by another, to his having seen Minerva bathing, who blinded him by sprinkling water upon him. In compensation, she gave him a staff by which he could guide his steps as safely as by sight, and ability to understand the voices of birds and thus know futurity. His oracle was at Orchomenus.

**TIRYNS**, one of the oldest cities of Greece, in Argolis, the site of which is 2 m. N. of Nauplia. The name is supposed to be an ancient form of *τύρρις*, a tower or castle. It was founded by Prœtus, and said to have been surrounded with walls by the Cyclops. These walls are the finest existing specimens of the military architecture of the heroic age of Greece. The ruins at present occupy the lowest hill of several which rise out of the plain, and the entire circuit of the walls enclosing the citadel is still preserved to some extent, being from 20 to 25 ft. wide and 350 yards in circumference. On the E. side of the hill are two towers, and the S. E. part of the wall has a remarkable covered gallery 36 ft. long and 5 ft. broad. In 468 B. C. Tiryns was entirely destroyed by the Argives.

**TISCHBEIN, Johann Heinrich Wilhelm**, a German painter, born at Haina, Feb. 15, 1751, died at Eutin, Oldenburg, July 26, 1829. He was one of a family of painters, resided several years in Rome, and was director of the academy of Naples from 1790 to 1799, when he returned to Germany. He excelled in drawing animals, but is chiefly known by illustrated works, including *Têtes de différents animaux dessinées d'après nature* (2 vols. fol., Naples, 1796); "A Collection of Ancient Vases, &c., in the possession of Sir William Hamilton" (4 vols. fol., Naples, 1790–1804, with 214 plates, engraved from Tischbein's designs); and *Homer nach Antiken gezeichnet*, with explanations by Heyne (fol., Göttingen, 1801–'4).

**TISCHENDORF, Lobegott** (Latinized ÆNOTHEUS) **Friedrich Constantin von**, a German Biblical palæographer, born at Lengenfeld in the Voigtland, Saxony, Jan. 18, 1815, died in Leipsic, Dec. 7, 1874. From 1834 to 1838 he studied philology and theology at Leipsic, where he published two prize essays: *Doctrina Pauli Apostoli de Vi Mortis Christi satisfactoria* (1837), and *Disputatio de Christo Pane Vitæ* (1839), and a volume of poems entitled *Maiknospen* (1838). He was for a year and a half a private teacher in the neighborhood of Leipsic, at which time he wrote *Der junge Mystiker*, a novel, published under the pseudonyme of Dr. Fritz. Devoting himself thereafter to textual criticism, he returned to Leipsic, wrote an essay on Matt. xix. 16, and a severe criticism of the published texts of the New Testament, with special reference to the edition of Scholz, and in 1841 published his own edition of the Greek Testament, embodying the various readings of the *textus receptus.* The years 1841–'4 were in great part spent by him in visiting the various libraries of Europe for the purpose of collating, copying, and publishing the most important New Testament manuscripts in their possession. In 1844, 1853, and 1859 he made journeys through the East, visiting numerous libraries and monasteries of Asia Minor, Palestine, the Sinaitic peninsula, and Egypt. He published accounts of two of these journeys, *Reise in den Orient* (Leipsic, 1845–'6), and *Aus dem heiligen Lande* (1862). With the exception of the last journey, which he made under the auspices of the emperor of Russia, he received pecuniary assistance for his travels from the Saxon government. In 1842, while at Paris, he prepared an edition of the New Testament intended for the use of Catholics, giving the Latin Vulgate and a Greek text, rendered as far as possible conformable to it, in parallel columns. He published also in the same year a Greek text differing very little from his earlier Leipsic edition. In 1843 appeared the New Testament portion of his publication of the Ephraem palimpsest of the 5th century. Two years later, when the remainder of this edition was

published, he was made professor extraordinary in Leipsic. The principal result of his first oriental journey, in 1844, was the discovery of 43 leaves of a Septuagint manuscript of the 4th century, then called *Codex Friderico-Augustanus*, but subsequently discovered to form part of the *Codex Sinaiticus*. The fragment was published in 1846 in lithographed facsimile. The same year also appeared the *Monumenta Sacra Inedita*, containing the manuscripts $F^a$, L, N, $W^a$, Y, and $\theta^a$ of the Gospels, and B of the Apocalypse. In 1847 he issued a portion of a manuscript of the old Latin version of the Gospels, and the *Wiener Jahrbücher* brought out serially during the following years his edition of the old Latin *Codex Bobbiensis*. In 1849 Tischendorf published a second edition of his Leipsic Greek Testament of 1841, fully revised according to all the material so far collected, and in 1850 the same text with marginal readings of the *textus receptus*, a correct reprint of the Vatican edition of the Septuagint with marginal readings of the Ephraem and Alexandrine manuscripts, and the New Testament according to the *Codex Amiatinus*, probably the oldest manuscript of the Latin Vulgate. In 1851 he obtained the prize offered by the society of the Hague for the defence of the Christian religion, with a dissertation entitled *De Evangeliorum Apocryphorum Origine et Usu*, and published his *Acta Apostolorum Apocrypha*, and a *Synopsis Evangelica*, a Greek harmony with the principal readings, and advocating the tripaschal theory. In 1852 he published a Græco-Latin manuscript of the Pauline epistles of the 6th century; in 1853 the *Evangelia Apocrypha;* and in 1854 a *Novum Testamentum Triglottum*, being the Greek text of 1849 revised, a critical edition of the Latin Vulgate, and Luther's German translation substantially after the edition of 1545, but corrected from other editions published in Luther's lifetime. The prolegomena and various addenda accompanying this work render it one of Tischendorf's most valuable publications. In his *Anecdota Sacra et Profana* (1855) he gives an account of the manner in which he secured the numerous manuscripts, describing also their general character. The larger part of the manuscripts which he obtained were deposited in the library of the university of Leipsic, while others were sold to the British museum and the Bodleian library. In 1855 he began a new collection of *Monumenta Sacra Inedita*, in nine volumes, of which he completed seven, and a seventh and larger critical edition of his Greek Testament of 1849 (2 vols., 1859). In 1856 he added to his Septuagint of 1850 the *Codex Chisianus* version of the book of Daniel. In 1859 he was made ordinary professor of theology and Biblical palæography, which chair was founded expressly for him. His third oriental journey, made in this year, resulted in the discovery at the convent of St. Catharine, near Mt. Sinai, of the famous *Codex Sinaiticus*. (See MANUSCRIPT.) He gave the first account of it in his *Notitiæ Codicis Sinaitici* (1860), and a more popular one in a pamphlet entitled *Die Sinaibibel, ihre Entdeckung, Herausgabe und Erwerbung* (1871). The Sinaitic manuscript was printed in facsimile type (4 vols. fol., St. Petersburg, 1862). Tischendorf received from the Russian government 100 copies, with permission to sell them at about $200 each. In 1863 was published an abridged edition of it, containing only the New Testament, Barnabas, and a portion of the Shepherd of Hermas, and giving the manuscript line for line, but in ordinary type. Tischendorf prepared in 1864 another edition of his *Synopsis Evangelica*, in which he adopted a large number of readings from the *Codex Sinaiticus*. His *Novum Testamentum Græce ex Sinaitico Codice* (1865) presented also the variations of the *textus receptus* and Vatican manuscript, and has a more elaborate introduction than the edition of 1863, for which however it does not form a complete substitute as a manual for critical purposes. In the same year appeared his *Wann wurden unsere Evangelien verfasst?* which met with an enormous sale, though in many respects sharply criticised by eminent Biblical palæographers. In 1866 Tischendorf published *Apocalypses Apocryphæ*, and added to a new edition of the treatise on the date of the Gospels a severe criticism of the arguments which had been brought out against his theories; and in this form the pamphlet was rapidly translated into nearly all modern languages. In *Appendix Codicum celeberrimorum, Sinaitici, Vaticani, Alexandrini* (1867), giving fragments of the *Codex Sinaiticus* found in the binding of some manuscripts, and an edition of the Alexandrine epistles of Clement of Rome, he expressed his opinion that one of the scribes of the Sinaitic manuscript wrote also the New Testament of the Vatican manuscript. The *Novum Testamentum Vaticanum*, a corrected edition of the one by Cardinal Mai, published by Tischendorf about the same time, was two years later supplemented by him with an *Appendix Novi Testamenti Vaticani*, which furnished also the Vatican text of the Apocalypse and corrected the errors of the main edition. His subsequent publications are all signed Constantin von Tischendorf, instead of Constantin Tischendorf, Alexander II. having conferred upon him the rank of a hereditary noble. With the assistance of B. Harris Cowper, he published in 1869, as the thousandth volume of the Tauchnitz collection of British authors, the authorized English version of the New Testament, with readings from the Sinaitic, Vatican, and Alexandrine manuscripts. In 1870 he brought out a corrected edition of the *Novum Testamentum Græce ex Sinaitico Codice* of 1865, and published a pamphlet, entitled *Responsa ad Calumnias Romanas*, in defence of his *Novum Testamentum Vaticanum*. The next year appeared a third edition of the *Synopsis Evangelica*, in

which several of the readings adopted for the second edition are omitted. In 1872 he completed the important eighth larger critical edition of his Greek Testament, which for fulness and accuracy excels all that preceded it. He published also the first of the two parts of an abridged edition of this valuable work; the second part was not completed at the time of his death. The minor editions of Tauchnitz and Brockhaus (1873) are corrected by this critical edition. In 1873 Tischendorf completed Theodor Heyse's edition of the Latin Vulgate, and in 1874 he published in conjunction with Baer and Delitzsch a *Liber Psalmorum Hebraicus et Latinus ab Hieronymo ex Hebræo conversus*. Shortly before his death appeared his 22d edition of the New Testament.

**TISHOMINGO,** a N. E. county of Mississippi, bordering on Tennessse and Alabama, bounded N. E. by the Tennessee river, and drained by affluents of the Tennessee and Tombigbee rivers; area, about 550 sq. m.; pop. in 1870, 7,350, of whom 741 were colored. The surface is hilly and the soil fertile. It is traversed by the Memphis and Charleston railroad. The chief productions in 1870 were 4,319 bushels of wheat, 188,836 of Indian corn, 18,578 of sweet potatoes, 1,397 bales of cotton, 3,999 lbs. of tobacco, 6,957 of wool, and 94,624 of butter. There were 1,117 horses, 2,091 milch cows, 7,140 other cattle, 4,547 sheep, and 9,183 swine; 1 cotton factory, 2 planing mills, and 5 saw mills. Capital, Iuka.

**TISSAPHERNES,** a Persian general, assassinated in Colossæ, Phrygia, in 395 B. C. In 414 Darius Nothus appointed him satrap of Lower Asia, S. of the Adramyttian bay, in place of Pissuthnes, then in revolt. He was ordered by the king to collect from the Hellenic cities within his jurisdiction the tributes in arrears for half a century, and also to slay or imprison Amorges, the son of Pissuthnes, who had rebelled and made an alliance with the Athenians. Tissaphernes obtained the aid of the Spartans through the influence of Alcibiades, who desired to support the Chians in their revolt against the Athenians. Throughout the ensuing contest, comprising the closing scenes of the Peloponnesian war, Tissaphernes acted treacherously to his allies. (See ALCIBIADES, and GREECE, vol. viii., p. 194.) In 407 Cyrus the Younger was appointed viceroy of the maritime region of Asia Minor. Hostility soon sprang up between him and Tissaphernes, who accused him, after the death of Darius, of aspiring to the throne of his brother Artaxerxes II. Tissaphernes, being one of the four generals who commanded the Persian army at Cunaxa, gained possession of the persons of the five generals commanding the Greek mercenaries of Cyrus, and put four of them to death. During the famous retreat of the 10,000 under Xenophon he continually harassed them as far as the Carduchian mountains. For his services he was made governor of the provinces formerly ruled by Cyrus, and as such he carried on war with the Spartans. Complaints against him constantly arrived at the Persian court, and Tithraustes was sent to put him to death. Tissaphernes was surprised in the bath and slain, and his head sent to Artaxerxes.

**TISSOT, Simon André,** a Swiss physician, born at Grancy, in the canton of Vaud, March 20, 1728, died in Lausanne, June 15, 1797. He studied at Geneva and Montpellier, settled at Lausanne about 1750, acquired great eminence as a practitioner, and became professor in the university. In 1780 he accepted the professorship of clinical medicine at Pavia, and in 1783 returned to Switzerland. His most important works are: *Historia Epidemiæ Lausaniensis Anni* 1755 (Lausanne, 1758; French, 1759); *L'Onanisme* (Latin and French, 1760; latest ed., revised and enlarged by M. A. Petit, Lyons, 1856); *Avis au peuple sur la santé* (1761; 12th ed., 1799); and *De la santé des gens de lettres, suivi de l'essai sur maladies des gens du monde* (1768–'70; new ed., revised by Bertrand de Saint-Germain, Paris, 1859). His complete works have been edited by Hallé, with a biography and annotations (11 vols., Paris, 1809–'13).

**TITANIUM,** a metal first detected in 1789 by Gregor in titanic iron, and found by Klaproth in 1794 in rutile, and named by him from the Titans. Dr. Wollaston in 1822 recognized it in the form of minute copper-colored cubical crystals found in the slags of the iron-smelting furnaces at Merthyr Tydfil in South Wales, and these, often met with since that time in iron slags, were formerly regarded as pure titanium, but are now understood to be compounds of the metal with nitrogen and cyanogen. Berzelius was the first to separate this metal in a state of purity. He decomposed a mixture of the fluorides of titanium and potassium by means of metallic potassium, and obtained the metal in a grayish powder. M. Sainte-Claire Deville obtained it in forms resembling specular iron ore, crystallized in prisms with a square base. Its chemical equivalent is 50; symbol, Ti. Three oxides of the metal are known, $TiO$, $Ti_2O_3$, and $TiO_2$; the last of which, titanic anhydride, is the only one of interest. It occurs as a mineral in three forms: as rutile and anatase, which both crystallize in the dimetric system, though with different angles, and as brookite, crystallizing in the trimetric system. Rutile is generally a reddish brown mineral. sometimes yellowish or black, harder than feldspar, and of specific gravity 4·18 to 4·25. It occurs in many parts of Europe and America, the richest localities in the United States being in Chester and Lancaster cos., Pa. In Vermont and New Hampshire, as also in Brazil and Switzerland, it is found in long needles enclosed in masses of transparent quartz, making very curious and beautiful specimens, which are often used in jewelry. Anatase and brookite are comparatively rare minerals. In combination with oxide of iron, titanic acid forms the compound ilmenite or

titaniferous iron. (See IRON ORES.) This is met with in large masses in Maryland, northern New York, and Canada. At Bay St. Paul on the St. Lawrence are beds of it, from 100 to 300 ft. long and 90 ft. thick, the ore, according to T. Sterry Hunt, containing 48·60 per cent. of titanic acid combined with 37·06 of protoxide of iron, 10·42 of peroxide of iron, and 3·60 of magnesia.—The only useful application of titanium is to furnish a yellow color in porcelain painting, and to give the proper tint to artificial teeth. The American supply for these purposes is derived from Pennsylvania. Tessie du Motay employs the strong attraction of titanium for nitrogen to produce ammonia directly from the atmosphere. If a mixture of titanic anhydride and charcoal, both in a minute state of division, be heated to whiteness and submitted to a current of air, nitrogen is rapidly absorbed, and carbonic oxide escapes. By passing steam over the copper-colored crystals which result, ammonia is copiously evolved, and it is claimed that the operation may be made continuous.

**TITANS,** in Greek mythology, the sons and daughters of Uranus (Cœlus) and Gæa (Terra). They were Oceanns, Cœus, Crius, Hyperion, Japetus, Cronus, Theia, Rhea, Themis, Mnemosyne, Phœbe, and Tethys. According to the most generally received account, Uranus feared his offspring, and as fast as they were born threw them into Tartarus. Gæa endeavored to persuade them to free her and themselves from this oppressive treatment. Cronus, armed with a sickle made by his mother, unmanned his father, and thus secured liberty and power for himself and his brothers. Marrying his sister Rhea, he begot three sons and three daughters, but, having been told that he would be destroyed by one of his own children, swallowed them as soon as they were born. Rhea concealed Zeus (Jupiter), the youngest, in a cave in Crete, giving to Cronus instead a stone wrapped in swaddling clothes. When Zeus had grown up, he was enabled by stratagem to make his father vomit up the stone and the five children he had swallowed. Supplied by the Cyclops with thunder and lightning, and aided by the Centimani, Zeus carried on a war against the Titans for ten years, and at length triumphed. The Titans, with the exception of Oceanus, were confined for ever in a subterranean dungeon, where they were guarded by the Centimani. The name of Titans was also given to their descendants.

**TITE,** Sir **William,** an English architect, born in London in 1802, died in Torquay, April 20, 1873. He studied under Laing, and early superintended the restoration of the church of St. Dunstan-in-the-East. He built the famous gothic Irvingite church in London, and several fine railway stations in France and England. His most celebrated work is the royal exchange, London. He was president of the institute of British architects from 1862 to 1864, a member of parliament for Bath from 1855 till his death, and was knighted in 1869. He was a high financial authority, and presided for some time over the London and Westminster bank and the bank of Egypt.

**TITHES** (Ang. Sax. *teotha*, a tenth), a tax of one tenth of the increase of crops, stock, and avails of personal industry, formerly and still in some countries levied for the support of the officers of religion, religious worship, or the assistance of the poor. This tax seems to have been of patriarchal origin (Gen. xiv. 20), and existed in many of the nations of antiquity. Under the Jewish theocracy the tenth part of the increase of the property of the Jews was accorded to the Levites, as a substitute for the landed inheritance which they forfeited by their consecration to the temple worship, and also as a compensation for their services. Other tithes were also prescribed for the sacrifices of the temple, and at particular periods for the poor. The early Christian church adopted voluntarily the custom of consecrating to religious purposes a tenth of the income, it being admitted that first fruits and tithes were not of divine precept in the new law, but held that the obligation of supporting the ministers of religion is of divine origin. It does not appear that the payment of tithes was ever enjoined as obligatory by the Greek or other eastern churches. The first known canonical enactment made for that purpose in the Latin church was a statute of the second council of Tours in 567, and this collection was enforced under pain of excommunication by the second council of Mâcon in 585. In France, Charlemagne established them by decree in the 8th century. In England the first law in relation to them is believed to have been that of Offa, king of Mercia, who brought the civil power to the aid of the clergy in collecting their tithes. This was subsequently extended over the whole of England by Ethelwulf. In the 9th century they were also made obligatory in Scotland, and not long after in Ireland. At first they were paid to whatever church the payer chose, but the decretal of Pope Innocent III. directed their payment to the parsons of the respective parishes in which they arose. By the ecclesiastical law tithes were divided into three kinds: "prædial," or such as arose immediately from the ground, like grain of all kinds, fruits, herbs, grasses, hops, wood, &c.; "mixed," natural products, but nurtured, and preserved in part by the care of man, such as wool, milk, pigs, butter, cheese, &c.; and "personal," as of manual occupations, trades, fisheries, &c. The first two kinds were payable in gross, but of the third class only the tenth part of the clear gains and profits was due. In France, Charlemagne divided the tithes into four parts, one to maintain the edifice of the church, another to support the poor, a third to maintain the bishop, and a fourth the parochial clergy. By the original law in England, all lands except those of the crown and of the church itself were tithable; but at the refor-

mation many of the forfeited church lands when sold were specially exempted, and some were also exempted by composition and some by prescription. These partial exemptions only made the burden more galling to those who were compelled to pay; and as the tithes were a tax for the support of the clergy of the established church, it was particularly annoying to dissenters, and has been for two centuries a constant subject of complaint. Until the reign of William IV. the payment of tithes might be exacted in kind, but by the act of 6 and 7 William IV., c. 71, and subsequent acts, tithes have been converted into a rent charge payable in money, but varying annually according to the average price of corn for the preceding seven years. In Ireland they had been compounded at three fourths their former estimated value previous to the disestablishment act of 1869, which abolished tithes, and created a common fund for the support of the Protestant Episcopal church and clergy. In France tithes were abolished at the revolution, and this example was followed afterward by the other continental states. In the Canadian province of Quebec tithes are still collected by the Roman Catholic clergy, in virtue of the old French law still in force there. In the United States tithes are only exacted by the Mormon hierarchy, and among them the system is modelled on that of the Jewish theocracy.

**TITIAN** (Tiziano Vecellio), an Italian painter, born near Pieve di Cadore, Friuli, in 1477, died in Venice, Aug. 27, 1576. He is said to have made his first attempts at coloring in his early childhood with juices expressed from flowers. In his ninth year he was placed under Sebastiano Zuccati, a Venetian painter and worker in mosaic, and subsequently studied under Bellini. He also came probably under the influence of Albert Dürer, who visited Venice in 1494 and again in 1507, but was indebted chiefly to his intimate friend and fellow student Giorgione for the ideas of art and color which long governed him. At Giorgione's death in 1511 the styles of the two artists were so similar that it was difficult to distinguish their productions, and Titian readily completed the unfinished works of his friend. Perceiving that breadth of form produced breadth of color, he endeavored to see nature in a more ample light, and, instead of copying or imitating her tones, to generalize and elevate them in accordance with his original conceptions. The result was a free and serene beauty of form and expression, and a representation of life realizing what Kugler calls "the glorification of earthly existence, and the liberation of art from the bonds of ecclesiastical dogmas." Left at the age of 34 without a rival, Titian entered upon a career which for the uniform excellence of its productions, for celebrity and duration, has perhaps no parallel in the history of painting. Commissions from the wealthy Venetian nobility afforded him abundant employment. In 1514 he visited the court of Duke Alfonso I. of Ferrara, for whom he painted the "Arrival of Bacchus in the Island of Naxos" and "A Sacrifice to the Goddess of Fertility," which are at Madrid, and the "Bacchus and Ariadne," in the British national gallery, which presents an epitome of all the characteristic beauties of Titian in composition, color, and form. At Ferrara he also painted portraits of Lucrezia Borgia and of Ariosto. He was again at Venice from 1516 to 1530, when he went to Bologna to paint the portraits of the emperor Charles V. and Pope Clement VII., and to Mantua, where he executed for the duke a series of the twelve Cæsars. At 65 he retained the vigor and freshness of youth, while the magic charm of his color and the cheerful serenity of his style seemed to mellow with time. In 1543–'5 he revisited Bologna and Ferrara, and painted the emperor Charles V. for the third or fourth time, and Pope Paul III. After passing some time in the employment of the duke of Urbino, he went to Rome, where he produced a masterpiece in his picture of the old pope with his grandsons, Cardinal Farnese and Duke Ottavio Farnese. While engaged upon a picture of Jupiter and Danaë, he was visited by Michel Angelo, who, after expressing admiration for his coloring, observed that if he had been early grounded in the principles of drawing, he would rank as the first painter in the world. In 1548 he was summoned by Charles V. to Augsburg, and received from him the title of count palatine of the empire and a pension. After the abdication of Charles he continued in great favor with his son Philip II. of Spain, for whom he painted important works; but his pension was thenceforth constantly in arrears, and he was frequently obliged to petition the Spanish officials for the sums due him for pictures. The remainder of Titian's life was passed principally in Venice. His "Martyrdom of St. Lawrence," in the Jesuits' church in Venice, painted when he was 81, is one of his largest and grandest compositions; and at least one of his celebrated Magdalens, that in the Escurial, was executed even later. At 90 years of age sorrow rather than time began to affect him, and, notwithstanding he clung resolutely to his art for consolation, the vigor and beauty of his style became impaired. In his 97th year he received Henry III. of France, who passed through Venice on his way from Poland, with magnificent hospitality; and two years later, while yet occupied with his art, he fell a victim to the plague. His latest work was a dead Christ with the Virgin and attendant saints, now in the academy of Venice. By a special exception in his favor he was buried in the church of Santa Maria de' Frari.—The works of Titian comprise sacred and profane history, mythological subjects, portraits, and landscapes, the last named being generally treated in connection with other subjects, though not always in subordination to them. Many of the pictures pass-

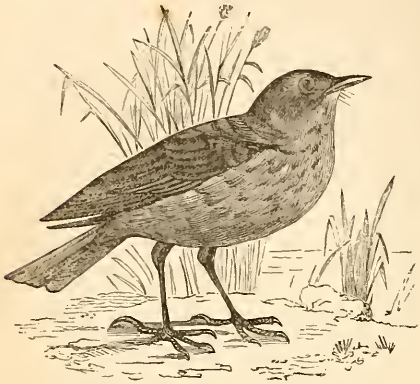
ing under his name are not well authenticated. He is seen to the best advantage in Venice. Of his early pictures, which reflect the style of the Bellini modified by the peculiar ideas derived from Giorgione, the most noticeable are the "Visit of Mary to Elizabeth," in the academy at Venice; the *Vierge au Lapin*, in the Louvre; the "Christ with the Tribute Money" (engraved by Gustav Eilers, Berlin, 1875), at Dresden; and particularly the "Resurrection," painted in five compartments, in the church of San Nazaro, at Brescia. The more developed period which succeeded the death of Giorgione comprises nearly all the pictures by which he is now known. The first in celebrity of these perhaps is the "St. Peter Martyr," in the church of Santi Giovanni e Paolo in Venice, which ranks with the "Martyrdom of St. Lawrence" among the painter's masterpieces. The academy of Venice contains his "Assumption" and "Presentation of the Virgin," and the Manfrini palace in the same city the "Entombment of Christ." In addition to these may be mentioned the "Last Supper," in the Escurial, upon which he labored seven years; a "Virgin and Child with Saints," in the Uffizi gallery; the "St. Sebastian," in the Vatican; the "Christ crowned with Thorns," in the Louvre; various well known Magdalens in Rome, Florence, the Escurial, and elsewhere; and numerous Madonnas, Holy Families, and similar pieces scattered over Europe. Upon subjects taken from allegory and secular history he executed several important pictures, including the "Victory of the Venetians over the Janizaries," for the doge's palace, which were destroyed by fire. As a colorist merely Titian developed the resources of his art with most success in naked female figures. The most familiar examples are the several Venuses in the galleries of Florence and Dresden; the Danaës at Naples and Vienna; the Flora in the Uffizi gallery; "Diana and her Nymphs" and "Venus rising from the Sea," in the Stafford gallery; "Venus and Adonis" (a duplicate), in the British national gallery; and the so-called *Vénus del Pardo* in the Louvre. As a portrait painter he is unrivalled; and Fuseli says that landscape dates its origin from him. —See Northcote's "Life of Titian" (2 vols., London, 1830), and that by Crowe and Cavalcaselle (1875).

**TITICACA**, a lake of South America, partly in Bolivia and partly in Peru, in the valley of the Desaguadero, more than 12,000 ft. above the sea. From recent but incomplete surveys it is estimated to be about 100 m. long, with an average breadth of 35 m. Scattered over its surface are many small islands containing the remarkable ruins called Tiaguanaco. These indicate a higher order of art than any existing at the time of the Spanish conquest, and a higher civilization than the aboriginal monuments at Palenque. According to the early Spanish chroniclers, the Peruvians had but the vaguest traditions of their origin, and there are striking evidences of their great antiquity. Some of the structures, on a pyramidal plan, appear to have covered several acres, but the most remarkable features still remaining are monolithic doorways, pillars, and statues elaborately sculptured in a style found nowhere else. One of these doorways is 10 ft. high and 13 ft. broad, with an opening 6 ft. 4 in. by 3 ft. 2 in., the whole cut from a single stone. Its E. front has a cornice, in the middle of which is a human figure crowned with rays, interspersed with serpents with crested heads. On each side are three rows of human and other figures, apparently symbolic. The statues are much broken, but their original dimensions were colossal. The whole neighborhood is strewn with vast blocks of stone elaborately wrought. The principal ruins are on an island bearing the same name as the lake, close to the S. W. shore. On some of the islands are other monuments of great extent, but of true Peruvian type, apparently the remains of temples destroyed on the arrival of the Spaniards. (See AYMARAS.) Since 1871 two small steamers, carried in pieces across the Andes, have been launched on the lake. A railroad extending about 220 m., across the Andes, from Arequipa to Puno on the W. shore of Lake Titicaca, was begun in 1870 and completed Jan. 1, 1874, at a cost of $32,000,000. It opens to market the wealth of the lake shores, alpaca wool, cinchona, chocolate, coffee, and other products, and the silver, copper, and timber of the surrounding mountains.

**TITJENS**, or **Titiens, Therese**, a German vocalist of Hungarian extraction, born in Hamburg in 1834, died in England, Oct. 9, 1877. She appeared upon the operatic stage in Hamburg at the age of 15, was engaged for the opera in Frankfort, and subsequently entered into an engagement for three years with the director of the imperial theatre at Vienna, during which she established her reputation as a representative of the greater rôles of the lyric stage, such as those of Leonora in *Fidelio*, Valentina in *Les Huguenots*, and Donna Anna in *Don Giovanni*. At the close of this engagement she transferred her services to Her Majesty's theatre, London, and subsequently took part in the great musical festivals in that country, being equally distinguished as an operatic and oratorio singer. In 1875 she visited America.

**TITLARK**, the popular name of the small dentirostral birds of the family *motacillidæ*, subfamily *anthinæ*, and genus *anthus* (Bechst.). They resemble the larks in their markings and in the long hind claw, and the wagtails in their movements and habits on the ground, and evidently are intermediate between these subfamilies. In this genus the bill is rather straight and slender, with the tip notched; wings very long, the first three quills equal and longest, and the tertials nearly as long as the primaries; tail moderate and slightly notched; tarsi and toes long and slender, the

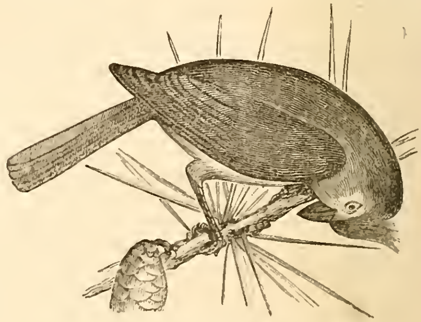
hind toe long with a very long sharp claw. The species are numerous, inhabiting most parts of the world and in every variety of region, some being migratory, others perma-



American Titlark (Anthus Ludovicianus).

nent residents. The nest is made upon the ground, of dry grass and stalks, lined with finer plants and hair; the eggs are four to six. The American titlark (*A. Ludovicianus*, Licht.) is 6½ in. long and 11 in. in alar extent; olive brown above, each feather darkest in the middle; beneath yellowish brown, the sides of the neck spotted longitudinally with dark brown; around eyes and superciliary stripe yellowish; central tail feathers like back, the others blackish brown, the external one mostly white and a white spot at the end of the second; primaries edged with whitish, and the other quills with pale brownish; bill and feet black. It is very generally distributed over North America, extending to the Pacific and to Greenland, and is accidental in Europe. The flight is exceedingly easy and graceful; it occurs in flocks of tens or hundreds running fast on the ground. It is found in the fields, on the prairies, along rivers, and on the sea shore; the notes are clear and sharp tweets, the last much prolonged; it breeds as far N. as Labrador, both sexes incubating, and sitting so closely as almost to allow themselves to be trodden upon before flying; the eggs are six, $\frac{5}{8}$ by $\frac{1}{2}$ in., reddish brown, with darker dots and lines at the larger end. The Missouri titlark (*neocorys Spraguei*, Sclater), 5½ in. long and 9½ in. in extent of wings, in song and habits comes the nearest of American birds to the European skylark.—Among the European species, the most extensively distributed is the meadow titlark or pipit (*A. pratensis*, Bechst.), also called titling; it is 6⅛ in. long and 9¾ in. in alar extent, olivaceous above, spotted with dusky; brownish white below, tinged anteriorly with red; neck, sides, and fore part of breast with oblong brownish black spots. It is of slender and elegant form, generally distributed over Europe, a permanent resident in Great Britain, and most abundant in meadows; it sings from the middle of April to the end of July, and rears two broods in a season; its notes are remarkably fine, the bird uttering them perched, seated, or flying, in the last case beginning at a considerable height, hovering a little while, and descending warbling to the ground. It is in the nest of this species that the cuckoo generally places its eggs.

**TITMOUSE**, the popular name of the *parinæ*, a subfamily of the warblers, found in all parts of the world except South America. The bill is short, strong, rather conical and straight, with the tip entire; nostrils generally concealed by the frontal plumes; wings moderate and pointed, with the first three quills graduated; tail more or less long, rounded and even; tarsi long, slender, and scaled in front; inner toe shortest; claws strong and curved.—In the typical genus *parus* (Linn.) the bill is somewhat curved, not very stout; the head is not crested; the fourth and fifth quills are equal and longest; the crown and throat generally black. There are more than 50 species described in North America, Europe, Asia, and Africa, small, sprightly, and bold birds, and many of them with beautiful colors. They sometimes do considerable damage in orchards by picking open the buds in search of insects. The nests are made in the forks of bushes and trees, of moss, grasses, and wool, lined with hair and feathers; many of the best known species deposit their eggs in holes of decayed trees, left by the woodpeckers or made by themselves; the eggs are six to twelve.—The largest of the well known American species is the tufted titmouse (*lophophanes bicolor*, Bonap.), 6¼ in. long and about 10 in. in alar extent; the crown has a conspicuous crest, the bill is conical with the upper and lower outlines convex, wings graduated with the first quill very short, and the tail moderately long and rounded. The color above is ashy black; frontal band black; under parts uniform whitish, sides brownish chestnut; sides of head nearly white, and bill black. It is found throughout eastern



Tufted Titmouse (Lophophanes bicolor).

North America to the Missouri, appearing in the middle states about May 1, in the summer inhabiting the forests, in flocks or families of eight or ten, in company with the nuthatch

and downy woodpecker; the note is a kind of pleasing whistle; the eggs are six or eight, white with a few red spots at the larger end, and are laid in holes of decayed trees.—In the genus *parus* (Linn.) belongs the black-capped titmouse or chickadee (*P. atricapillus*, Linn.). (See Blackcap.) The largest of the European species is the great titmouse or tit (*P. major*, Linn.), called also oxeye and black-cap in England, and *la charbonnière* in France; it is less than 6 in. long, with the head, fore part of neck, transverse band on sides, and longitudinal one on breast and abdomen, black; cheeks white, back yellowish green, and breast and sides yellow; wings and tail grayish. Its usual note is a loud cheep followed by a harsh chatter, in the spring resembling the filing of a saw and heard to a great distance; it imitates the notes of other birds, and in its habits

Hanging Tit (Paroides pendulinus).

and food shows an alliance to the jays; in its search for flies it visits the cottage tops and pulls the straw from the thatch; it is found from Norway and Sweden to the southern boundaries of Europe. The blue tit (*P. cæruleus*, Linn.) is 4¾ in. long and 7¾ in. in alar extent, with the upper part of the head light blue and encircled with white; band round neck, and before and behind eyes, duller blue; cheeks white, back light yellowish green, under parts pale grayish yellow, and middle of breast dull blue. This is the handsomest and most familiar species; in autumn it quits the woods and thickets and visits the gardens and orchards, incessantly hopping about among the branches, pert and irritable; it is called tomtit, bluecap, bluebonnet, and billy-biter in various parts of England. It is a permanent resident in Great Britain; it is very bold when sitting, hissing like a snake or angry kitten, and severely biting the hand brought near the nest.—The hanging tit (*paroides pendulinus*, Koch), 4½ in. long, is reddish gray above, with wings and tail blackish, and lower parts rosy white; it is found in eastern and northern Europe, and constructs very artistically a nest woven of the fibres of bark and the cotton of the seeds of willows, fastened to a reed or thin branch and surrounded by closely tangled bushes, which protect it from the wind and hide it from view.

**TITUS**, a N. E. county of Texas, bounded N. by Sulphur fork of Red river, S. by Big Cypress bayou, and intersected by White Oak bayou; area, 940 sq. m.; pop. in 1870, 11,339, of whom 2,818 were colored. The surface is generally level and the soil fertile. The county is well timbered, and contains iron ore. The chief productions in 1870 were 382,029 bushels of Indian corn, 5,632 of oats, 48,343 of sweet potatoes, and 7,039 bales of cotton. There were 3,437 horses, 4,597 milch cows, 10,784 other cattle, 3,798 sheep, 28,711 swine, and 7 saw mills. Capital, Mount Pleasant.

**TITUS** (Titus Flavius Sabinus Vespasianus), a Roman emperor, born Dec. 30, A. D. 40, died near Reate in the Sabine country, Sept. 13, 81. He was the son of Vespasian, and was educated in the imperial household with Britannicus, the son of Claudius, who was poisoned by Nero. While still young he served as military tribune in Britain and Germany, and subsequently became quæstor. During the Jewish war he commanded a legion under his father, and captured Tarichæa, Gamala, and other places. When Vespasian, proclaimed emperor by his army, went to Rome, he left Titus to end the Jewish war, which he accomplished in September, 70, by the capture of Jerusalem and the massacre and dispersion of its inhabitants. Subsequently he returned to Rome by the order of his father, carrying with him Berenice, the daughter of Herod Agrippa, with whom he had fallen in love (see Berenice), and by his prompt obedience proved that the rumors which charged him with aiming at the throne were unfounded. For their common success in the Jewish war he had with his father the honor of a triumph, and the arch of Titus then erected is still standing. (See Rome, vol. xiv., p. 412.) During the remaining years of the reign of Vespasian he was employed in discharging the highest functions of state. He drew up the imperial edicts, and was permitted to write letters in the emperor's name. He ascended the throne in 79, and soon dispelled the impression, produced by some features of his earlier conduct, that he would be another Nero. The people called him *amor et deliciæ generis humani*, and Suetonius records that he exclaimed, *Amici, diem perdidi*, whenever a day passed without his being able to do a service to a friend or petitioner. His reign was marked by a succession of terrible calamities, the injuries inflicted by which he made earnest efforts to repair. In 79 the

towns of Herculaneum, Stabiæ, and Pompeii were destroyed; in 80 a great fire broke out in Rome which lasted three days, and a plague began to ravage the city, of which thousands died daily. Titus almost exhausted his finances in order to relieve his unfortunate subjects, repaired many aqueducts, made a road from Rome to Ariminum (the modern Rimini), completed the Colosseum, which his father had begun, and also constructed the baths called the baths of Titus. In dedicating these two last, he gave magnificent entertainments, which continued 100 days, on one of which 5,000 wild beasts are said to have been set fighting in the new amphitheatre. He checked all prosecutions of *læsa majestas*, and punished all informers. He pardoned his brother Domitian, who several times had attempted to supplant him. Meanwhile his health declined, and going to the Sabine country, he expired in the same villa in which his father had died. Titus is said to have written Greek poems and tragedies.

**TITUS**, a companion and fellow laborer of the apostle Paul. He was a Greek, and was one of those persons sent from Antioch to Jerusalem to consult the apostles, and it was not judged necessary that he should be circumcised. He accompanied Paul to Jerusalem, was his agent at Corinth and in Dalmatia, and was left with ecclesiastical commissions on the island of Crete. According to ecclesiastical authorities and tradition, he was the first bishop of Crete.

**TITUS, Epistle to**, a canonical book of the New Testament, addressed by the apostle Paul to his disciple Titus. This and the two epistles to Timothy form the pastoral letters of the apostle, all of which have so many points in common that their authenticity has been generally attacked and defended simultaneously. The date of the Epistle to Titus has been the subject of much dispute, some fixing it as early as the year 52, others as late as 65, others at various intermediate years. The apostle furnishes Titus, whom he had left behind in Crete, with rules of conduct for himself, especially in regard to the appointment of elders (i. 5–9), and certain false teachers (i. 10–16), as well as for Christians in general (ch. ii. and iii.). The commentaries on the Epistles to Timothy generally include also the Epistle to Titus. (See Timothy, Epistles to.)

**TITUSVILLE**, a city of Crawford co., Pennsylvania, on Oil creek, 85 m. N. by E. of Pittsburgh, and 40 m. S. S. E. of Erie; pop. in 1870, 8,639; in 1875, about 10,000. It is in the midst of a fine dairy region, and is surrounded by hills. The streets are broad, straight, and well paved; the dwellings are of wood and brick, and are surrounded by gardens; the business blocks are of brick. It is well drained, lighted with gas, and has Holly water works. It communicates with Buffalo, Erie, Pittsburgh, and other points by means of the Dunkirk, Alleghany Valley, and Pittsburgh, the Oil Creek and Alleghany River, and the Union and Titusville railroads. Titusville is the chief place in the oil region, and owes its prosperity to the petroleum wells in the vicinity. It had only 300 inhabitants in 1859, when the production was commenced. It contains seven oil refineries, using 6,000 barrels of crude petroleum daily; three oil-barrel factories, besides a number of cooper shops, together producing 3,000 barrels a day; four iron works and founderies, manufacturing steam engines and boilers, stopcocks and pipe fittings, and oil-well tools, and also doing brass casting and finishing; two sulphuric acid factories, two flouring mills, two lager-beer breweries, four banks, a high school, four ward schools, two Roman Catholic schools, two daily and weekly newspapers, and 12 churches.

**TIVOLI** (anc. *Tibur*), a town of Italy, in the province and 16 m. E. N. E. of the city of Rome, on the Teverone (anc. *Anio*) and on the slope of Mt. Ripoli; pop. about 6,000. It is remarkable for magnificent scenery and for its antiquities, which include villas, bridges, and the temples of the Sibyl and of Vesta. The celebrated falls of the Anio were best seen from the grottoes of Neptune and the Sirens till 1826, when the artificial wall over which they flowed was destroyed by an inundation. The course of the river was then diverted by cutting two long tunnels through the rock of Mt. Catillo, finished in 1834; the new falls thus formed are exceedingly picturesque, as well as the numerous small cascades in the W. part of the town.—The ancient Tibur, probably a Siculian city, was one of the early rivals of Rome. As a member of the Latin league, it was, after a protracted struggle, taken in 338 B. C., and deprived of a part of its territory. Remaining nominally independent, it became a resort of Roman exiles. It was famed for the worship of Hercules in one of the most beautiful temples of the period, and for its associations with illustrious Romans who had villas here during the republic and the early days of the empire. The domain of Hadrian, S. of Tibur, extended over 8 m., and included many public buildings besides a magnificent palace. In the middle ages the town again became important. Pius II. built the castle in its present form near the gate Santa Croce.

**TLAXCALA**, or **Tlascala** (Aztec, "land of bread"), a state and city of the republic of Mexico. The state is bounded W. by the state of Mexico, and on all other sides by that of Puebla; area, 1,498 sq. m.; pop. in 1871, 121,665. In area it is the smallest of the Mexican states, not including the federal district. It received its name from its great fertility in maize. The city, capital of the state, is between two mountains on an upper branch of the river Mescala, 20 m. N. of the city of Puebla, and 70 m. E. by S. of Mexico; pop. about 5,000. It has a cathedral, state house, bishop's palace, and the oldest Franciscan convent in Mexico.—The Techichimecs founded the Tlaxcalan republic, which successfully resisted all

efforts of surrounding tribes and even of the Mexican monarchy for its subjugation. In 1519 the Tlaxcalans resisted the march of Cortes, but, after being defeated in four battles, they submitted as vassals to Spain, but refused to abjure their religion. (See CORTES.) The city is said to have numbered at the time of the invasion about 20,000 families, and Sept. 18, the day of Cortes's entrance, is still celebrated there.

**TLEMCEN,** a town of Algeria, in the province and 68 m. S. W. of the city of Oran; pop. in 1872, 18,722, including 3,000 French. It is the strongest Algerian fortress on the Moroccan border, and one of the most picturesque places of the country. It has about 30 mosques, the most magnificent being that of Sid Ibrahim. Trade and industry are active, and increasing in consequence of improved communications. It was originally called Jiddah, and for several centuries was, with occasional interruptions, the capital of an independent kingdom, with a population estimated at more than 100,000. Many vestiges of its former splendor remain. (See *Histoire des rois de Tlemcen*, from the Arabic, by the abbé Bargès, Paris, 1852.) In the 16th century it fell under the domination of the Turks, who allotted it to the dey of Algiers. The inhabitants having revolted in 1670, the place was burned. The French, after a brief occupation, restored it in 1837 by treaty to Abd-el-Kader, and they did not recover possession until after partly destroying the town in 1842, since which time they have greatly strengthened the fortifications.

**TOAD,** the common name of a well known family of anourous or tailless batrachians, the general character and anatomy of which have been described under AMPHIBIA and FROG. The *bufonidæ*, which comprise the common toads, have a well developed tongue, jaws rather sharp at the edge but without teeth, thick and heavy body, and skin more or less covered with glandular warts which secrete an acrid fluid; the hind legs are but little longer than the anterior. According to Agassiz, the toads should rank higher than the frogs, from their more terrestrial habits; the embryonic web, which still unites the fingers of the frog, disappears in the toad, and the cutaneous glands of the skin do not exist in frogs. Toads, like frogs, absorb moisture by the skin, which is cast at intervals, coming off in lateral halves which are swallowed by the animal at a gulp; the skin feels hard to the touch, and, according to Mr. Rainey ("Microscopic Journal," 1855), contains a layer of earthy matter under the dermis effervescing with acids, considered by him the analogue of what becomes a continuous hard dermal skeleton in the testudinata. Like frogs, they have also a large sac resembling a bladder, often found filled with pure water, in no way connected with the kidneys, but formed of the allantois, serving as a reservoir of water and aiding in respiration, its walls being highly vascular. The acrid fluid of the skin may be pressed out from two eminences like split beans just behind the head; it comes forth in a jet, and will make the eyes smart severely if it touches them. The hyoid bone being absent, the root of the tongue is attached anteriorly in the concavity formed by the branches of the lower jaw, the free extremity pointing backward when at rest; it is capable of protrusion in a reversed position so rapidly that the eye cannot follow it. They are not only inoffensive, but of great service to man in destroying noxious insects and larvæ; they usually lie hid during the day, but come out at dusk in woods, fields, and gardens, in search of food, and are not unfrequently found in cellars and dark places about houses; their metamorphoses are of the same character as those described under FROG; they live out of the water except during the breeding season in March or April; during winter they remain torpid in holes and crevices, under stones, stumps, &c.; they lay a great number of eggs

Common European Toad (Bufo vulgaris).

united into long strings, enclosed in a gelatinous substance, generally two, which the male draws out with his hind feet. The species are less numerous than in the terrestrial and tree frogs; they are found in both hemispheres, but unequally distributed, being most abundant in America, and least so in Europe, which has not a single species peculiar to it, both the common toad and the natterjack occurring also in Africa and Asia; they are more abundant in Asia than in Africa, and only one is described in Australia; Duméril and Bibron recognize only 35 species of *bufonidæ*.—In the genus *bufo* (Laur.) the tongue is oblong, free posteriorly; anterior limbs four-toed and free, the posterior five-toed and semi-palmated; the tuberosity behind each eye, above the tympanum, porous and cushion-shaped; head obtuse in front, the upper jaw descending directly downward so that the intermaxillaries do not project in front of the cranium. The common European toad or paddock (*B. vulgaris*, Laur.), *le crapaud* of the French, is 3 to $3\frac{1}{2}$ in. long, of a lurid brown-

ish gray, with reddish brown tubercles and a blackish stripe externally or along the glands on the sides of the head; the iris red or golden; the body thick and much inflated. It feeds on insects and worms of all kinds, but will touch only a living and a moving prey; it remains motionless, with eyes fixed on its intended victim till it comes within reach of its tongue, which is darted out with extreme rapidity and accuracy; when it seizes a worm, it pushes it into the mouth with the fore feet till all disappears, and the animal is swallowed whole. Its motions are by a kind of crawl; when alarmed it stops and swells out the body, and sometimes makes short and awkward leaps. The eggs are in a double series, 3 or 4 ft. long and two lines thick, and are laid in the spring two or three weeks later than those of the frog, the young being fully developed by the last of summer; they are smaller and blacker in all their stages than the young of the frog. Small toads of this and the common North American species are often found in places, such as gardens and cellars, where they could neither have had access to water nor have been introduced from without, and therefore could not have gone through the usual stages of tadpole existence; the gills must have disappeared shortly after birth, if they ever existed; they appear to have the power of prematurely assuming the functional conditions of terrestrial animals when circumstances demand it; a similar rapid metamorphosis is observed as a rule in the Surinam toad mentioned below. (See "Annals and Magazine of Natural History," vol. xi., London, 1853.) The toad has been regarded as venomous in almost all countries and ages, its saliva, bite, and cutaneous and watery secretion being supposed to be poisonous and more or less maleficent; the acrid exudation from the skin is sufficient to produce a painful irritation on a tender skin or a wounded mucous membrane; though it will make a dog quickly drop a toad from its mouth, it has no effect when introduced into the circulation; it not only serves thus for the protection of the animal, but is probably partly excrementitious, and assists the lungs in freeing the blood of carbon. The toad has been known to live 35 or 40 years, and it is thought to attain a considerably greater age; it has been so far domesticated as to come and feed from the hand, and seems capable of attachment to man. From their well known fondness for insects, toads make excellent traps for the entomologist, who may thus procure rare and otherwise unattainable beetles and nocturnal species, which they can be made to disgorge without difficulty; gardeners often put them into hot-houses to destroy ants and other insects and larvæ. Like many reptiles, the toad can live a considerable time without food and with a very small supply of air; but the alleged instances of their being found imbedded in solid stone or the heart of a tree, with no possible communication with the external world, have no doubt arisen from errors of observation. Dr. Buckland's experiments in 1825, in connection with the so-called antediluvian toads, show that these animals cannot usually survive a long time, not even a year, deprived of air and food. (See "Curiosities of Natural History," by his son Francis T. Buckland, 1st series, London, 1859, pp. 74–86.) —The other European species is the natterjack, or mephitic or green toad (*B. calamita*, Laur.); it is less than 3 in. long, of a light yellowish brown color clouded with dull olive, and with a bright yellow stripe along the middle of the back; under parts yellowish with black spots, and the legs with black bands; iris yellowish green; it is less tumid, and the eyes more prominent; the hinds legs are shorter and the toes less palmated, indicating more terrestrial habits; it is less common, more active, and frequents drier places; it is found throughout Europe, and in Asia and N. Africa. —The common American toad (*B. Americanus*, Le Conte) is 2½ to 3 in. long, with short, thick, and bloated warty body; anterior limbs large, posterior short with a spade-like process at root of first toe, described as a rudimentary sixth toe by some writers; the jaws entire, and the eyes large and brilliant. It has a longitudinal line of dirty white from the occiput to the vent, on each side several spots of various colors, size, and shape, and a row of black and whitish ones extending to the hind legs; lower parts granulated and dirty yellowish white; anterior limbs dusky above with small white spots, the posterior ashy with blotches and bands of black. The head is smaller than in the European toad, the body less bloated, and the movements more active. In the breeding season toads and frogs do not generally assemble in the same pond; this species has been found on sandy shores overgrown with beach grass and in salt marshes; it is met with from Maine and Canada to the Mississippi valley; its note is a prolonged trill, continued by day and night.—There are several toad-like batrachians, generally arranged by modern herpetologists in the frog family. One of these, the accoucheur toad (*B. obstetricans*, Laur.; genus *alytes*, Wagler), is common in the vicinity of Paris, France, and in S. Germany; the males not only assist the females in the exclusion of the eggs (which are yellow), but afterward attach them to their hind legs by small pedicles; the young are developed under ground in the femoral region until they reach the tadpole state, when the males enter the water and the young escape.—The family *pipidæ* constitute the group of *phrynoglosses*, so named from having no tongue, as distinguished from the *phaneroglosses*, in which this organ exists; the head is triangular, and the small eyes are low and near the mouth; the body is broad and thick, the hind legs very powerful and large, and the toes united by a complete and full web. The family contains only two genera, *pipa* (Laur.) and *dactylethra*

(Cuv.), each with a single species. In *pipa* there are no teeth, and the last joint of the slender anterior toes is divided into four parts. In *dactylethra* the upper jaw has small pointed teeth, the tongue is at the back of the mouth, and some of the hind toes have (alone among batrachians) hoof-like claws; the anterior legs are small and slender; the *D. Capensis* (Cuv.)

Surinam Toad (Pipa Americana).

is found at the Cape of Good Hope and on the Mozambique coast. The Surinam toad (*P. Americana*, Laur.) has a remarkable and anomalous mode of reproduction; the eggs do not escape into the water, but are received by the male, who deposits them on the back of the female and there impregnates them (some authors say that impregnation takes place before the deposition of the eggs on the back of the female); the skin becomes thickened between them, rises, and partly invests each egg in a sac or pouch, covered by a thin operculum of dried gelatinous matter, probably a portion of that which originally surrounded the egg; the young go through the usual changes in the dorsal pouches, and emerge perfect toads; the yolk is large; the external branchiæ disappear at a very early period; the tail is fully formed in the embryo, but is absorbed before it leaves the egg; the embryo at this stage is larger than the original egg, so that it must have absorbed something from the pouch of the parent. This animal is commonly found in the dark corners of houses in Guiana, and, though very large and exceedingly disgusting in appearance, is said to be eaten by the natives.

**TOAD FISH,** a spiny-rayed fish of the *lophius* family, and genus *batrachus* (Bloch), so named from its large head, wide gape, usually naked skin, and disgusting appearance; it is also called frog fish and oyster fish. The head is flattened and wider than the body; teeth conical, small and crowded on the intermaxillaries, larger on the lower jaw, palate, and vomer; operculum small and spiny; head, lips, and cheeks provided with numerous fleshy appendages; lower jaw the longer; first dorsal short, with three spinous rays almost concealed in the skin; second dorsal and anal low, soft, and long; ventrals under the throat, narrow, with three rays; pectorals on short arms of five carpal bones; fourth branchial arch without gills; body generally scaleless; no pyloric cæca; air bladder deeply forked anteriorly, attached to the vertebræ by slender ligaments, and muscular on the sides. They hide in the sand and mud of salt water, and occur in both hemispheres, preying on fish. There are more than a dozen species, of which one of the best known is the grunting toad fish (*B. grunniens*, Bloch), found in the seas of the East Indies; the skin is naked, smooth, soft and spongy; the head and jaws with numerous cutaneous appendages; the color is brownish above, marbled with darker, below white, fins white with brown bands; it is 8 to 13 in. long, and is said to be eaten at Bombay; it received its specific name from its making a grunting noise like a pig, from the expulsion of air by the muscular air bladder through the mouth.—The common American toad fish (*B. tau*, De Kay) is much like the East Indian, with half a dozen more rays in the second dorsal and anal, stronger teeth, more prominent dorsal spines, and rather darker colors; it is 8 in. to a foot long, light brown, marbled with black, and the fins with black lines; the body is covered with a copious viscid secretion; the mouth very large, and the chin and cheeks with numerous fleshy appendages. It is found from Maine to the gulf of Mexico and the West Indies, on the New England coast usually in ponds and lagoons connected with the sea, in muddy shoal water, or under eel grass and stones. The disgusting appearance of this fish, its slimy body, goggle

American Toad Fish (Batrachus tau).

eyes, and immense mouth, have generally prevented the use of its flesh as food, though it is said to be delicate, palatable, and wholesome; it is a savage biter, and capable of inflicting severe wounds. Other species are found in the Indian and African seas, and some larger ones with soft scales on the Brazilian coast.

**TOBACCO,** the plant and the dried and prepared leaves of *Nicotiana tabacum* and other species of *Nicotiana*, a genus of the *solanaceæ* or nightshade family. (See SOLANUM.) The name of the genus commemorates that of Jean Nicot, a French ambassador to Portugal, who in 1560 sent the seeds from Lisbon to France, as those of a highly valuable medicinal plant which was then known throughout Portugal, having been introduced in 1520. The botanical specific name, and the common name, come

from *tobago* or *tabaco*, the native term in Santo Domingo for the tube or pipe through which the smoke of the burning leaves was inhaled. The native Brazilian name for the plant was *petum* (now used as a generic name for the related *petunia*), which the Portuguese introduced into Europe, and it is occasionally met with in old works. The genus *Nicotiana* is mostly American, containing about 50 species, mainly herbs, with leaves, stems, &c., covered with viscid hairs; calyx tubular-bell-shaped and five-lobed; corolla funnel-shaped, with a five-lobed limb; stamens five, inserted on and included by the corolla; ovary two-celled, ripening into a two-celled capsule, surrounded by the persistent calyx, and opening by two or several valves for the escape of the numerous, very small, kidney-shaped, roughened seeds. The species most generally cultivated is *N. tabacum*, a stately plant, 3 to 6 ft. high, with ample, oblong-lance-shaped leaves, which are

Tobacco Plant in Flower (Nicotiana tabacum).

mostly decurrent upon the stem, and decrease in size toward the summit of the plant; the flowers are in a large terminal panicle, the rose-purple corolla about 2 in. long., with a somewhat inflated throat and short lobes. This species was extensively cultivated by the natives before America was visited by Europeans, and has not been detected in a truly wild state. *N. rustica*, according to Humboldt, was largely cultivated by the ancient Mexicans, as it was by the more northern aborigines; it is occasionally found as a weed as far north as New York state, and occurs in various other parts of the country as a relic of its cultivation by the Indians; though a native of tropical America, it is more hardy than the common species; it was early introduced into cultivation in Europe, and has become naturalized in the southern parts of that continent. It has ovate, petioled leaves, and dull greenish yellow flowers, which are much smaller than those of *N. tabacum*. As its leaves in drying retain much of their color, it is sometimes called green tobacco, and being earlier and more hardy, it is better suited to northern localities than the common species; it comes to maturity in Canada, and is cultivated in northern Germany, Sweden, and Russia, and various eastern countries; the Turkish, Hungarian, and Latakia tobaccos are of this species. Chinese tobacco is accredited to *N. Chinensis*, and that of Shiraz to *N. Persica*, species of doubtful origin and identity. *N. repanda* is said to be raised in Cuba for the manufacture of a particular brand of cigars. The tobacco formerly cultivated by the Indians of Missouri and further west was, according to Nuttall, *N. quadrivalvis*, a low, much branched plant, with short, lanceolate, sessile leaves, and nearly white flowers, opening only at sunset; its native country is unknown.—Tobacco is largely produced in China, Japan, Persia, and other parts of the East, in some of which the plant has become so thoroughly naturalized that an eastern origin has been sometimes claimed for it; but Alphonse de Candolle, after a thorough study of the subject, finds no satisfactory evidence that its uses and culture were anywhere known before the discovery of America.—In speaking of the cultivation and uses of tobacco, the common species, *N. tabacum*, is intended, unless otherwise mentioned. Like some other plants of the family, as the potato and tomato, tobacco readily adapts itself to new conditions, and it becomes to a certain extent acclimated. The influences of climate and soil upon the development of plants are strikingly illustrated in tobacco as cultivated in the United States; it is grown from near the borders of Canada to the gulf of Mexico, and almost from ocean to ocean, and several states produce a leaf of such well marked characteristics that a good judge can at once tell the locality of its growth. The valley of the Connecticut produces a leaf which is large, thin, and remarkably fine and silky, and which, though deficient in flavor, is so superior for wrappers, or the outer covering of cigars, that it is even sent to Cuba for that use. In the attempts to improve the flavor of the tobacco of the Connecticut valley, seeds from Cuba and other localities have been tried there; but it is found that in a very few seasons the tobacco, from whatever source the seeds are obtained, becomes similar to that which has long been raised there; it has also been found that when Connecticut valley seeds are sown in other localities the plants in two or three generations give a product almost precisely like that peculiar to the locality.—The first European cultivation of tobacco took place in Portugal, in the early part of the 16th century; it was raised in France in 1572, a box full of powdered leaves having been sent to Catharine de' Medici, who acquired a taste for it, and the plant was for a time called *herbe de la reine*. The culture rapidly extended to other parts of Europe and to Asia,

in some cases being checked by severe laws or made useful as a source of revenue. Its production in England, by a law of 1660, was restricted to a very small quantity for medicinal purposes, and the prohibition still remains in force. The earliest settlers in Virginia engaged in the cultivation of tobacco, as it was a salable commodity in England; but as early as 1616, when the colony only numbered 351 persons, a provision was made by law against neglect of food crops in its favor.—In the cultivation of tobacco the first step is to sow the seeds in a seed bed; the success of the crop greatly depends upon the management of this. A spot with a warm exposure and well sheltered is selected, a temporary fence being sometimes put up to protect it from the winds, and as soon as the soil is thawed the bed is highly manured and spaded or ploughed. It is very common to put upon the bed a covering of brush, burn it, and rake the ashes into the soil; this burning destroys all the seeds of weeds near the surface, and leaves the soil in good condition. The seeds of tobacco are so exceedingly minute that it is said an ordinary thimbleful, if each germinated, would produce more than enough plants for an acre; but, as is usually the case with very small seeds, a large proportion of them will be covered too deeply and fail. The surface of the bed being raked fine, the seed is carefully mixed with several quarts of lime, ashes, sand, or other material to aid in its distribution, and sown with the greatest care broadcast, and the surface well rolled. After sowing, the bed receives the closest attention; watering when needed, applying liquid manure, covering with mats or straw on cool nights, and when the plants are well up killing destructive insects and weeding, are among the labors needed to insure success. When the plants are about 4 in. high they are ready to be transplanted; the field is previously prepared, and can hardly be made too rich; stable manure and a great number of artificial fertilizers are applied to this most exhausting crop; the land is marked out in rows 3 ft. apart one way and 2 ft. the other for small varieties, which will give 7,000 plants to the acre, while for larger kinds the rows are 3 ft. one way and 4 ft. the other, allowing 4,200 plants to the acre. Transplanting is done in cloudy weather, the plants being set at the intersection of the rows; they soon become established, and during their growth receive the most thorough cultivation. When the leaves are as large as one's hand, the tobacco needs "worming." Various insects attack it, but the most destructive is the large "green worm," the larva of a sphinx; the common tobacco worm in western states is *sphinx Carolina*, but *S. quinque-maculata*, commonly found on the potato and tomato, feeds upon tobacco in the eastern states; both are large, night-flying moths, with five inches spread of wing and a long coiled proboscis; in their larval state they eat voraciously and grow rapidly, forming when full grown a caterpillar 3 in. long, as large as one's finger, and having an ornamental horn (not a sting) at its tail end. These will ruin the leaves in a short time; the whole farm force is frequently needed to "worm" the tobacco, and it must be guarded from these attacks during its whole growth; the worms are killed by pinching them between the thumb and finger. When the plants and the worms are small, a flock of young turkeys may be employed, but later in the season there is no substitute for hand picking. Some have killed the parent insects by placing sirup poisoned with arsenic in the large tubular flowers of the common thornapple or Jamestown weed (*datura stramonium*) and placing these about the field. "Priming" is the name given to the breaking off of such leaves as touch the ground and become broken and soiled; this is not practised by all planters, some preferring to cure all the leaves and put the poor ones by themselves. "Topping" is the stopping of the upward growth of the plant by breaking off the upper end of the stem, in order that the nourishment which would otherwise go to the production of flowers and seed may be diverted to the greater development of the lower leaves; some top when the first blossom buds show, and others leave a given number of leaves, 10 to 16, as experience has proved most profitable. The upward growth of the plant being checked by topping, branches soon appear in the axils of the leaves; these are called suckers, and the operation of removing them is "suckering," which is done as soon as those on the upper part of the plant are large enough to get hold of, and the laborious work must be kept up as long as any suckers appear. The maturity of the crop is judged of by the color and the feel of the leaf; over-ripeness is more injurious than its opposite. Cutting is sometimes done as soon as the dew is off in the morning, and the tobacco housed as soon as wilted; others cut in the afternoon, and house the next morning. A hatchet or a knife like a corn knife is used, the stalk being severed close to the ground with one blow, and laid down, where it remains long enough to wilt so that it may be handled without breaking the leaves, but not so long as to be sun-burned. Where it is an important crop, large buildings (tobacco houses) are erected expressly for it; these are so arranged that the ventilation is under perfect control; there are several ventilators in the roof, and each alternate board of the upright siding is hung on hinges, and so arranged that all may be opened or closed at once; the best houses are provided with a stove. The methods of hanging tobacco to dry vary greatly; the old way is to hang the plants upon poles, which are supported at each end by timbers arranged for the purpose; the plants are tied to the poles with a strong twine; they hang tops downward, and are placed upon alternate sides of the pole and such distances

apart that the leaves will not touch. A very common way of hanging is on laths; these are 4 ft. long, 1¼ in. wide, and ⅝ in. thick; an iron spear about 8 in. long, with a socket to fit upon the lath, is placed upon one end, and by its means the tobacco is strung upon the lath, the spear passing through the stalk near its larger end; this work is done in the field, and the laths with their load are hung upon rails in the barn. Besides these methods of hanging there are several patented contrivances intended to facilitate the work and at the same time keep the plants far enough apart. During the drying close attention must be paid to ventilation; as the leaves dry they must not be broken by the wind; if hung too close, the tobacco will "pole burn;" if it does not dry quickly enough, the green leaves may freeze and be spoiled; fire heat is often used, which improves the color, but is objected to by some as injuring the flavor; it ordinarily takes about 12 weeks to cure. When quite cured, the tobacco is stripped; the house is opened in a damp time, and when the leaves have absorbed so much moisture from the air that they will not break, the tobacco is taken from the poles and put in piles, where it will remain pliant for a week. In stripping, the leaves are at the same time assorted, four qualities being usually made. The first stripper takes a stalk and picks off all the defective leaves near the base, and throws it to the next; the second stripper removes all of the next quality, and so on; the leaves are kept even and smooth, and when the stripper gets enough for a "hand," which is 3 or 4 oz., he binds them together into a bunch by means of another leaf. Up to this stage the tobacco is simply the dried leaves, without the aroma and other qualities for which it is esteemed; these are developed only after it has undergone a fermentation or is "conditioned," to effect which the leaves are "bulked." The merchants who purchase the tobacco frequently prefer to "condition" it in their own warehouses; when this is the case, the hands are simply baled for transportation. "Bulking" consists in stacking the tobacco in a compact heap, the buts of the hands laid outward, the leaves being carefully smoothed as they are placed down; in a rude way the bulk is made on a platform of boards raised above the ground sufficiently to allow of a circulation of air beneath; when the pile is 3 or 4 ft. high, planks and weights are placed upon it, and it is covered if need be with blankets. In this state it remains until the color, flavor, and other qualities are properly developed, which requires from four to six weeks. Bulking being the finishing process, the quality of the crop depends upon its proper management, and it requires frequent attention. Tobacco is sent to market in boxes containing about 400 lbs., or in casks holding 1,300 to 1,500 lbs.; in packing in casks the buts of the hands are laid toward the outside and trodden down by the bare feet of the packer; when about 100 lbs. are thus packed, pressure by means of a screw or a powerful lever is applied, after which more tobacco is placed in, pressed again, and so on till the cask is full.—The yield of marketable tobacco to the acre depends upon numerous contingencies; but the average is not far from 600 lbs., while some growers harvest 1,000 lbs. annually, and this is exceeded in particular cases. Tobacco growers are very careful in the matter of seed; the tendency of the plant to vary has already been noticed, and it is the custom of some growers to save a large supply of seed from a desirable crop, as when well kept it remains good for six to ten years.—The various kinds of foreign tobacco are known by the names of the countries producing them, or the ports whence they are shipped, such as Havana, Orinoco, Turkey, Latakia, Shiraz, &c.; that grown in this country bears the name of the state or some particular locality, while the product of the Connecticut valley and some other localities bears the unmeaning name of "seed leaf." Virginia tobacco is one of the strongest kinds, not fitted for cigars, but is made into various shapes for pipes, and for chewing, and used for snuff; Maryland is paler and weaker, and used for pipes; Kentucky is intermediate between the two, and in this as with the Missouri there is much variety; the Florida is now becoming known as a fine tobacco, and used for cigars; the best of the northern kinds for making cigar wrappers is the Connecticut, and those from New York, Ohio, and other northern states are valued in proportion as they approach this in texture, as for this use strength or flavor is not required; the body of the cigar being made of Havana, a leaf that has an attractive color and silky feel is sought for. (See CIGAR.) The Turkish and other kinds from the East are only used cut fine for pipes, or granulated for cigarettes. Manila tobacco is imported only in the form of peculiar conical cigars called cheroots. Very fine tobacco is produced in Paraguay, and small quantities have been imported.—In whatever manner the tobacco may be manufactured (except for snuff), the first step is to "strip" it. The hands, being moistened to prevent breaking, are untied, and the strong midrib of the leaf is removed; this work is done by women and children; the upper surfaces of the leaf are folded together lengthwise, and the midrib dexterously separated by a pull; the "stems," as the midribs are called, are used in the poorer kinds of cut tobacco and snuff, but are nearly

Hand of Tobacco.

a waste product, being sold at low rates for making sheep dip to destroy ticks on those animals, and for fumigating greenhouses to destroy insects. Some tobacco is sold which seems to be of the leaf merely stripped, made into a roll, and subjected to moderate pressure, without any foreign substance, and some of the cut tobacco is of this kind; but the greater part of that made up into cakes, heads, plugs, or pigs, as the parcels are variously called, as well as that which is cut for both smoking and chewing, is prepared by various processes to meet the taste of the consumers; molasses, liquorice paste, a decoction of figs, and glycerine are used to impart a sweet taste, give color, and prevent rapid drying; common salt and other salts are used for flavoring, and nitrate of potash or soda is sometimes added to increase the combustibility; anise and other aromatics are added for their flavor, and smoking tobaccos have their odor increased, if not improved, by the use of cascarilla bark, and lately *liatris odoratissima*, the leaves of which are largely collected in Florida and sold as "wild vanilla" or deer's-tongue (see VANILLA); these contain a great deal of coumarine, the aromatic principle of the Tonqua bean, a seed employed for scenting snuff. These additions, except those for odor, are made in the form of a liquid technically termed "liquor" or "sauce," in which the leaves are steeped.—To make cut tobacco, the leaves are made up into large cakes, which are cut into shreds or filaments by the action of machines similar in principle to straw-cutters. In this condition the tobacco is put up in a great variety of packages, which are marked with fanciful names. The dark-colored leaves, made still darker by the liquoring process, produce the coarse variety called shag, and the better sorts are converted by spinning processes into cords variously folded or twisted, and distinguished by different names. The term "negro head" is applied to coarse rolls of tobacco weighing 6 or 8 lbs. each. The variety known as "pig-tail" is also spun; the cord, but little larger than a pipe stem, is often braided, and then oiled and packed closely in kegs. In the United States a great deal of tobacco, intended chiefly for home consumption, after being cut up, is made into flat cakes, which are moistened with molasses and powerfully compressed; these cakes are about 5 in. long and 1½ in. wide, and when closely packed in the strong oak boxes in which they are sent to market, they form a compact mass, from which the cakes are torn out only by the application of considerable force; this, known as plug or Cavendish tobacco, is in common use for chewing, and is smoked in pipes by those who are fond of tobacco of the strongest flavor.—Snuffs vary greatly in quality, the poorer kinds being made from the "stems," or midribs of the leaves, separated in preparing tobacco for other purposes; in the finer kinds these are rejected, the blade or better portion of the leaf only being used; and in intermediate qualities both parts are ground up together, and the refuse or dust from the cutting machines is used. There are two principal classes of snuffs, the dry and the moist. The dry snuffs are prepared from tobacco which has been exposed to a high temperature before grinding, and they differ in quality according to the proportion of stem they contain; they are usually very finely powdered, of a light yellowish brown color, and from their excessive dryness are very diffusible in the air, and need careful handling; lime is said to be sometimes mixed with these snuffs, to increase their dryness, and those so treated have an injurious effect upon the membranes of the nose. The Scotch or yellow snuff is the commonest of this class; this is usually packed in bladders; yellow ochre is often added to improve the color and as a cheap adulteration to increase the weight. The names of some of the brands indicate the method of preparation, such as "high-dried" and "high toast." The Irish and Welsh snuffs belong in this class; one of the most celebrated Irish brands is Lundy Foot, taking its name from the original makers, Lundy, Foot and co. The moist snuffs present a greater number of varieties. They are prepared by grinding the tobacco while moist, and are subjected to various manipulations. The finely divided tobacco is moistened, usually with a solution of salt, and placed in a heap to ferment; the extent to which this fermentation is carried, the fineness of the subsequent grinding, the addition of perfumes, and the admixture of other substances to increase the pungency or to maintain its moist condition, all vary in producing the different commercial varieties. Carbonate of potash, in the form of pearlash, readily attracts moisture from the atmosphere, and is sometimes added to keep the snuff damp. Salt is added to all moist snuffs, and is not regarded as an adulteration, as it is considered necessary to prevent mould. Various essential oils are used to perfume particular brands, the most common being those of bergamot and rose; powdered orris root and rosewood are both used for this purpose. The color of the snuff is due to the extent to which it is fermented. The leading brands of moist snuffs are rappees (Fr. *râper*, to rasp) of various kinds (coarser-grained than other varieties), prince's mixture, maccoboy (Fr. *macouba*), Dutch carrottee, Grand Cairo, &c. Snuff is much more largely consumed in Great Britain and France than in the United States. In Scotland the rappee snuff is generally preferred, the so-called Scotch snuff being used chiefly by women of the lower classes.—The first analysis of tobacco was made by Vauquelin in 1809, who detected a volatile acrid principle, which was not isolated till 1828, by Posselt and Reimann, as a colorless oily liquid, which was called nicotine or nicotia, and is the constituent upon which the active properties of the plant chiefly depend. (See NICOTIA.) The proportion of this alkaloid

in the dried leaves varies from less than 2 per cent. in Havana to nearly 8 per cent. in tobacco produced in the department of Lot in France. The occurrence of nicotia in tobacco smoke is asserted by some chemists, while others have failed to detect it. Another constituent is tobacco camphor, or nicotianine, a concrete volatile oil which appears on the surface of the distillate as minute crystals when the leaves are distilled with water; very discrepant accounts are given of its sensible properties, which have not been sufficiently studied. Besides these the leaves contain a bitter extractive matter, gum, malate of lime, chlorophyl, albuminoids, malic acid, woody fibre, and various salts. The amount of ash is very large, varying from 16 to 27 per cent. Wolff found in 1,000 parts of air-dried leaves 197·5 of ash, composed as follows: potash, 54·1; soda, 7·3; magnesia, 20·7; lime, 73·1; phosphoric acid, 7·1; sulphuric acid, 7·7; silica, 19·0; chlorine, 8·8. The leaves contain from 2½ to 4½ per cent. of nitrogen, partly in the form of nitrates; this, with the large content of potash and phosphoric acid, shows the heavy draft made by the crop upon the fertility of the soil, which can only be maintained by the most liberal manuring. By dry or destructive distillation at a red heat, an empyreumatic oil is obtained, of about the color and consistence of molasses, with acrid taste, and precisely the odor of an old pipe; this is powerfully poisonous; under the name of oil of tobacco it is used in ointments for skin diseases. This oil has been detected in tobacco smoke together with nicotianine (as some assert), nicotia, salts of ammonia, hydrocyanic acid, sulphuretted hydrogen, several volatile fatty acids, phenol, creosote, and numerous basic substances of the picolinic series. It appears therefore that the physiological effects of smoking cannot be directly deduced from, although closely allied to, those of tobacco administered by the mouth or otherwise.—The admixture of some of the materials used in the processes of manufacturing tobacco cannot be properly called adulterations, as they are added to suit the tastes of consumers. Water, necessary to bring the leaf into proper form, may be sometimes fraudulently used to increase the weight, and those who keep the unmanufactured tobacco in store are careful that it shall not lose in this respect; the other additions, of various saccharine and saline matters, have already been mentioned. In England, where tobacco bears a high price, there is a temptation to add other materials, and, especially in cut tobaccos, various vegetable substances have been detected; dock, rhubarb, coltsfoot, and other leaves, malt sprouts, and peat are among the most important; but the use of these is not frequent, as detection in the adulteration of tobacco, and even their possession by a tobacconist, are punished by a fine of £200. The microscope serves for the detection of these adulterations, the structure of the true leaf being quite distinct from that of any likely to be mixed with it. The various salts, such as nitrates to increase the combustibility, and others to modify the flavor or to increase the weight, are detected by chemical tests. Snuff is more liable to adulteration than any other form of tobacco; common salt is a very frequent addition; ochres and other earthy matters, pearlash to absorb moisture, oxide of lead, and various other foreign substances, including powdered glass (supposed to be accidental), have been detected.—The medicinal effects of tobacco upon the system are very marked, whether it is taken internally or applied externally. In small quantities, taken by either of the methods in which it is commonly used, as smoking, chewing, or snuffing the pulverized dry leaf, it acts as a sedative narcotic; in larger quantities, or with those unaccustomed to it, it causes giddiness, faintness, nausea, vomiting, and purging, with great debility; as the nausea continues with severe retching, the skin becomes cold and clammy, the muscles relaxed, the pulse feeble, and fainting and sometimes convulsions ensue, terminating in death. Its power of causing relaxation of the muscular system is great, and has been taken advantage of in surgical treatment, as by Dr. Physick in a case of obstinate and long continued dislocation of the jaw, the desired effect being produced by smoking, to which the patient was unaccustomed. An infusion or the smoke of tobacco has been introduced into the rectum to facilitate the reduction of a hernia or intestinal obstruction; but it is now entirely superseded for these purposes by the more effectual and less dangerous ether or chloroform. Its physiological action is nearly opposed to that of strychnia, to which it has been used as an antidote. It is also applied in the form of infusions and cataplasms to relieve various spasmodic affections, and its use generally in medicine is in external applications, the nausea it occasions almost wholly preventing its exhibition internally. It is recommended in articular gout, rheumatism, and neuralgia; and the toothache is often relieved by smoking a cigar. The application of the infusion, or even of the leaves, or of powdered tobacco, to surfaces deprived of the cuticle, has sometimes been attended with fatal effects; these have even followed the inhalation of the smoke. The powerfully nauseating effects of tobacco suggest its use as an emetic, but it is rarely resorted to for this purpose. Entirely different opinions have been entertained by the most respectable medical authorities as to the effects of tobacco upon the system, whether beneficial or hurtful, as it is commonly used; and ever since its early introduction many have earnestly condemned it for its supposed universally injurious qualities. Its use nevertheless has been constantly increasing, and multitudes among all nations depend upon it daily, suffering extremely if deprived of it for a time. Attempts have been made to show that the use

of tobacco lessens mental vigor, but it would be very easy to produce abundant instances to prove that its action in this direction can be but slight. Its use, however, is specially to be avoided by persons who have not reached their full bodily development. Medical authorities are able to trace pretty clearly to its extreme use certain forms of pharyngitis, dyspepsia, palpitation of the heart, and so-called nervousness. A form of blindness known as tobacco amaurosis is recognized by oculists; this is sometimes, but not usually, attended by actual atrophy of the optic nerve, and is generally very amenable to treatment.—In Spain and Spanish American countries women smoke as well as men, while in England and North America the use of tobacco by women, except in the form of snuff, is very rare, and the use of snuff by women is becoming less frequent. The use of snuff for "dipping" appears to be peculiar to the southern states; it avoids the unpleasant effects of snuffing, and has been largely practised in secret as well as openly; it is done with a small brush, which is first wetted, then dipped in snuff, and applied to the gums; it is thought to brighten the eyes and improve the complexion of the young, but the older soon abandon it for the pipe.—The general estimate of the crop of leaf tobacco in 1875 is: Virginia, 65,000 hhds.; Maryland, 35,000; Ohio, 15,000; Kentucky and Tennessee, 100,000; Illinois and Indiana, 30,000; Missouri, 30,000; total, 275,000 hhds. In January, 1876, the average values of leaf tobacco per hhd. were: Kentucky, $150; Virginia, $120; Maryland, $60; Ohio, $60; at which rates the total value of the estimated crop of 1875 would be $29,400,000. The annual consumption in the United States is estimated at 60,000 to 75,000 hhds. Of seed-leaf tobacco the stock on hand on Jan. 1, 1875, was 180,000 cases; exported during the year, 35,000; consumption, 70,000; packed in hogsheads and for cutting purposes, 10,000; total, 115,000; leaving stock on hand Jan. 1, 1876, 65,000 cases, to which must be added the estimated crop of 1875, as follows:

| STATES. | Cases. | Price. | Value. |
|---|---|---|---|
| Connecticut and Massachusetts.. | 40,000 | $70 | $2,800,000 |
| New York.................. | 10,000 | 30 | 300,000 |
| Pennsylvania.............. | 30,000 | 60 | 1,800,000 |
| Ohio...................... | 15,000 | 30 | 450,000 |
| Wisconsin and other W. states.. | 10,000 | 30 | 300,000 |
| Total..................... | 105,000 | .. | $5,650,000 |

The receipts and shipments of American leaf tobacco at the principal tobacco ports in the United States in 1875 were as follows:

| PORTS. | Received, hhds. | Shipped, hhds. |
|---|---|---|
| New York.................. | 46,932 | 54,831 |
| New Orleans............... | 4,017 | 4,447 |
| Virginia.................. | 38,966 | 22,450 |
| Baltimore................. | 40,290 | 42,930 |
| Total..................... | 130,205 | 124,658 |

The exports of all kinds of tobacco from the port of New York in 1875 were: leaf in hhds., 54,831; cases, 30,668; bales, 45,122; ceroons, 13,515; stems in hhds., mostly to Germany, 2,253; manufactured tobacco, 6,554,936 lbs. The greater part was distributed as follows:

| COUNTRIES. | Hhds. | Cases. | Bales. | Ceroons. |
|---|---|---|---|---|
| Great Britain.......... | 16,103 | 751 | 88 | ...... |
| Germany................ | 3,333 | 22,816 | 28,060 | 12,754 |
| Spain.................. | 11,718 | ...... | ...... | ...... |
| France................. | 3,909 | 50 | 25 | 761 |
| Italy.................. | 12,625 | ...... | ...... | ...... |

Manufactured tobacco was exported as follows: to Great Britain, 2,866,560 lbs.; Germany, 86,713 lbs.; West Indies, 754,365 lbs.; South America, 1,109,155 lbs.; Australia, 1,246,262 lbs.; and in less quantities to Belgium, Holland, Portugal, the Mediterranean, Africa, the British North American provinces, China, and India. The receipts of Cuban tobacco in the United States in 1875 were 82,819 bales.—See Joubert, *Nouveau manuel du fabricant de tabac* (Paris, 1844); Hassall, "Adulterations detected in Food and Medicine" (London, 1857; new and enlarged ed., 1876); H. P. Prescott, "Tobacco and its Adulterations" (London, 1858); "The Uses and Abuses of Tobacco," by John Lizars, professor of surgery (Edinburgh; reprinted, Philadelphia, 1859); Fairholt, "Tobacco, its History and Associations" (London, 1859; new ed., 1875); "Tobacco Culture, by Fourteen Experienced Cultivators" (New York, 1863); and "Tobacco," by John Dunning, in the "British Manufacturing Industries" (1876).

**TOBACCO PIPE.** See PIPE, TOBACCO.

**TOBAGO,** an island of the Windward group of the British West Indies, the N. point of which is in lat. 11° 25′ N., lon. 60° 32′ W., 32 m. long; area, 120 sq. m.; pop. in 1871, 17,054. It is a mass of rocks which rises abruptly on the N. E. side and descends toward the S. W., the most elevated part of which is about 900 ft. above the sea. There are several good harbors on the N. side for vessels of 150 tons, and a few on the S. side. The valleys are well watered by numerous streams. The productions are sugar, molasses, and rum. The value of imports in 1874 was £43,743; of exports, £45,280. It has a lieutenant governor, subordinate to the governor of the Windward islands, a privy council, a legislative council of 7 members, and a house of assembly of 16 members, elected by the parishes. The capital is Scarborough, on the S. coast.—Tobago was discovered by Columbus in 1498, and was ceded by France to Great Britain in 1763.

**TOBIT,** a book of the Old Testament in the Roman Catholic canon, but regarded as apocryphal by Jews and Protestants. It contains the history of Tobit or Tobias, a pious Jew of the tribe of Naphtali, living in exile at Nineveh. Being purveyor to the court of King Shalmaneser, he became wealthy; but under

Sennacherib he lost his position and his property, because he had buried Jews who had been executed. Having returned to Nineveh after the death of Sennacherib, he became blind; but he was cured by the application to his eyes of the gall of a fish which his son Tobias had brought home from a journey undertaken in company with the angel Raphael. The Greek text of the Septuagint, which some writers believe to be the original, and the Latin translation of Jerome, which he claims to have made from a Chaldaic text, differ considerably. The author is supposed to have been a Jew of Palestine, who, according to Ewald, most probably wrote in the far East about 350 B. C. Among the best commentaries are those of Fritzsche (Leipsic, 1853), Sengelmann (Hamburg, 1859), and Reusch (Freiburg, 1857).

**TOBOLSK.** **I.** A government of Russia, in western Siberia, extending from the Arctic ocean to the Central Asian provinces of Akmolinsk and Semipolatinsk, separated on the west by the Ural mountains from European Russia, and bounded E. by Yeniseisk and Tomsk; area, 531,964 sq. m.; pop. in 1870, 1,086,848. It is traversed by the Obi and its principal tributaries, and contains extensive lakes. Timber abounds in the south. Its great mineral resources are not yet properly explored. The land on the banks of some of the rivers yields much grain. Fish and game, including furbearing animals, are especially plentiful. The transit trade with China is considerable. **II.** A city, capital of the government, on the right bank of the Irtish, at the confluence of the Tobol, nearly 1,200 m. E. N. E. of Moscow; pop. in 1867, 20,330. It contains a cathedral and many other churches, several mosques, an episcopal palace, an arsenal, a theatre, and a gymnasium. Inside the citadel is a workhouse for Siberian exiles of the lower classes. The manufactures are unimportant.

**TOCANTINS**, a river of Brazil, formed by the Almas and Maranhão, which rise in the province of Goyaz and unite in lat. 14° S., lon. 49° 15′ W. After a course of about 1,000 m., in a general northerly direction, it falls into the Rio Pará, about 80 m. S. W. of the city of the same name. The Araguay, Parannan, Great Somno, Tucahunas, and Theresa are its affluents. The tide ascends about 300 m., and at its mouth the Tocantins is 8 m. wide.

**TOCQUEVILLE, Alexis Charles Henri Clérel de**, a French author, born in Paris, July 29, 1805, died in Cannes, April 16, 1859. He studied law, was appointed a judge in Versailles in 1826, was promoted in 1830, and in 1831 was sent with Gustave de Beaumont on a mission to the United States, to examine the penitentiary system. The report of their observations was published under the title *Du système pénitentiaire aux États-Unis* (8vo, 1832; translated into English by Francis Lieber, 8vo, Philadelphia, 1833). De Tocqueville investigated at the same time the political and social institutions of the country, and wrote his celebrated philosophical work *De la démocratie aux États-Unis* (2 vols. 8vo, Paris, 1835), which received the Montyon prize, and procured his admission to the academy (1844). He was elected in 1839 to the chamber of deputies, and became the leader of a moderate wing of the opposition. As a member of the constituent assembly in 1848, he opposed socialistic doctrines and ultra-democratic measures. After attending the diplomatic conferences in Brussels upon Italian affairs, he became minister of foreign affairs, June 2, 1849. He strongly supported the French expedition to Rome, but, dissatisfied with Louis Napoleon in other respects, he resigned at the end of October. On Dec. 2, 1851, he protested against the *coup d'état*, and was imprisoned, but released after a few days, when he retired to private life. In 1856 he published *L'ancien régime et la révolution* (8vo; translated by J. Bonner, 12mo, New York, 1856). His *Œuvres et correspondance inédites* have been published with a biographical notice by G. de Beaumont (2 vols. 8vo, 1860; English translation, 2 vols. 8vo, London and Boston, 1861). His complete works are in 9 vols. (Paris, 1860–'65). His "Democracy in America" was translated into English by Henry Reeve, with a preface and notes by John C. Spencer (8vo, New York, 1838; new ed., London, 1875; abridged ed., "American Institutions and their Influence," with notes, 16mo, New York, 1856); and Reeve's translation has been edited by Prof. F. Bowen (2 vols. 8vo, Cambridge, 1862).—See "Correspondence and Conversations of Alexis de Tocqueville with Nassau William Senior," edited by M. C. M. Simpson (2 vols., London, 1872).

**TOD, James**, an English soldier, born in 1782, died in London, Nov. 17, 1835. He went to India in 1800 as a cadet in the East India company's service, and attained the rank of lieutenant colonel. After the Mahratta war, he was engaged to survey Rajpootana, of which a topographical map was finished in 1815. He was political agent of Mewar and other Rajpoot states from 1817 to 1823. He wrote "Annals and Antiquities of Rajasthan" (2 vols. 4to, London, 1829–'32), and "Travels in Western India" (4to, 1839).

**TODD.** **I.** A S. W. county of Kentucky, bordering on Tennessee, and drained by Pond river and several large creeks; area, 350 sq. m.; pop. in 1870, 12,612, of whom 4,860 were colored. The surface is generally hilly and the soil fertile. It is intersected by the Louisville and Nashville and Great Southern and the St. Louis and Southeastern railroads. The chief productions in 1870 were 178,837 bushels of wheat, 445,275 of Indian corn, 57,375 of oats, 13,490 of sweet potatoes, 2,620,193 lbs. of tobacco, 18,925 of wool, 65,260 of butter, and 1,633 tons of hay. There were 2,363 horses, 1,789 mules and asses, 2,000 milch cows, 2,423 other cattle, 7,300 sheep, and 18,370 swine. Capital, Elkton. **II.** A central county of Minnesota,

watered by Long Prairie and Partridge rivers and other streams; area, 960 sq. m.; pop. in 1870, 2,036. The surface is generally level, interspersed with numerous small lakes, and the soil is productive. The Northern Pacific railroad passes through the N. part. The chief productions in 1870 were 15,907 bushels of wheat, 18,012 of oats, 13,736 of potatoes, 25,683 lbs. of butter, and 3,339 tons of hay. There were 74 horses, 337 milch cows, and 613 other cattle. Capital, Long Prairie. **III.** A S. E. county of Dakota, bordering on Nebraska, and lying between the Missouri and Niobrara rivers; area, about 550 sq. m.; pop. in 1870, 337. The river bottoms are very fertile; the uplands consist of prairies. Capital, Fort Randall.

**TODD, Henry John,** an English clergyman, born in 1763, died at Settrington, Yorkshire, Dec. 24, 1845. He was educated at Oxford, and was vicar of Milton near Canterbury, rector of Allhallows, London, keeper of the manuscripts at Lambeth palace (1803), rector of Settrington (1820), prebendary of York (1830), and archdeacon of Cleveland (1832). His publications comprise "Illustrations of the Lives and Writings of Geoffrey Chaucer and John Gower" (8vo, 1810); an edition of Johnson's "Dictionary," with corrections and additions (4 vols. 4to, 1814); "Memoirs of the Life and Writings of Brian Walton" (2 vols. 8vo, 1821); "A Letter to the Archbishop of Canterbury, concerning the Authorship of Icôn Basilikè" (8vo, 1825); "Some Account of the Life and Writings of John Milton" (8vo, 1826); and a life of Archbishop Cranmer (2 vols. 8vo, 1831).

**TODD, James Henthorne,** an Irish antiquary, born in Dublin, April 23, 1805, died near there, June 28, 1869. He graduated at Trinity college, became a fellow there in 1831, and was regius professor of Hebrew in the university of Dublin. He was also treasurer and precentor of St. Patrick's cathedral, president of the royal Irish academy, and one of the founders of the Irish archæological society. He edited several rare Irish manuscripts and tracts, including "The Wars of the Danes in Ireland," and published "Historical Tablets and Medallions" (1828); "Discourses on the Prophecies relating to Antichrist" (1840); "Historical Memoirs of the Successors of St. Patrick and Archbishops of Armagh" (2 vols. 8vo, 1861); and "St. Patrick, Apostle of Ireland" (1863). He collected a library of manuscripts, which after his death brought extraordinary prices.

**TODD, John,** an American clergyman, born in Rutland, Vt., Oct. 9, 1800, died in Pittsfield, Mass., Aug. 24, 1873. He graduated at Yale college in 1822, spent four years at the Andover theological seminary, and was ordained to the ministry in the Congregational church at Groton in 1827. In 1833 he was settled over the Edwards church at Northampton, in 1836 was called to the pastorate of the first Congregational church in Philadelphia, and from 1842 to 1872 was pastor of the first Congregational church in Pittsfield, Mass. He was one of the founders of Mount Holyoke female seminary, and for several years was president of the trustees of the young ladies' institute of Pittsfield. In 1845 he received the degree of D. D. from Williams college. His principal works, most of which have passed through many editions both in the United States and England, and several translated into other languages, are: "Lectures to Children" (2 vols. 16mo, Northampton, 1834; 2d series, 1858); "Student's Manual" (12mo, 1835); "Index Rerum," prepared for noting books read (4to, 1835); "Truth made Simple" (18mo, 1839); "Great Cities, their Moral Influence" (18mo, 1841); "Lost Sister of Wyoming" (18mo, 1841); "The Young Man" (18mo, 1843); "Simple Sketches" (2 vols. 16mo, Pittsfield, 1843); "Pastor's Daughter" (24mo, 1844); "Stories on the Shorter Catechism" (2 vols. 18mo, Northampton, 1850–'51); "Summer Gleanings" (12mo, 1852); "The Daughter at School" (12mo, 1854); "The Angel of the Iceberg, and other Stories" (18mo, 1859); "Future Punishment" (32mo, New York, 1863); "Mountain Gems" (4 vols. 16mo, Boston, 1864); "Nuts for Boys to Crack" (16mo, New York, 1866; 8vo, 1868); "Polished Diamonds" (16mo, Boston, 1866); "Serpents in the Dove's Nest" (18mo, 1867); "Woman's Rights" (18mo, New York, 1868); "The Water Dove, and other Gems" (18mo, Edinburgh, 1868); "Mountain Flowers" (16mo, Northampton, 1869); "Sunset Land, or the Great Pacific Slope" (Boston, 1869); and "Old-Fashioned Lives" (1870). Several collective editions of his works were published from 1853 to 1868.—See "John Todd, the Story of his Life, told mainly by Himself, compiled and edited by Rev. John E. Todd" (16mo, New York, 1876).

**TODD, Robert Bentley,** a British physiologist, born in Dublin in 1809, died in London, Jan. 30, 1860. He was educated in Trinity college, Dublin, went to London in 1831, became professor of physiology and anatomy in King's college in 1837, and was also professor of clinical medicine in King's college hospital. He had great reputation as a practitioner, and published "Cyclopædia of Anatomy and Physiology" (4 vols. 8vo); "The Physiological Anatomy and Physiology of Man" (2 vols. 8vo), in conjunction with Dr. Bowman; "Anatomy of the Brain, Spinal Cord," &c.; "Lectures on Paralysis and Brain Diseases;" and "Treatise on Gout and Rheumatism."

**TODDY TREE.** See Palm, vol. xiii., p. 18.

**TODHUNTER, Isaac,** an English mathematician, born in Rye in 1820. He graduated at Cambridge in 1848, and became mathematical lecturer at St. John's college. He has published a series of works on higher mathematics for college instruction, which enjoy great favor in England. The most important of his works on the philosophy and history of mathematics are the "History of the Progress of the Calculus of Variations during the 19th Century"

(1861), "Researches on the Calculus of Variations" (1872), and "History of the Mathematical Theories of Attraction and the Figure of the Earth, from the Time of Newton to that of Laplace" (2 vols., 1873).

**TODLEBEN, Franz Eduard,** a Russian military engineer, born in Mitau, Courland, May 20, 1818. He was educated at the school of engineers in St. Petersburg, and after being employed in that department he served in the Caucasus against Shamyl from 1848 to 1851, and against the Turks on the Danube in 1853–'4. He displayed great genius in the defence of Sebastopol, and was wounded, June 20, 1855. Subsequently he was employed in strengthening Nikolayev and Cronstadt. In 1860 he became chief of engineering in the war office, with the rank of general, and he is at the same time the adjunct of the grand duke Nicholas in the general direction of this service. His history of the defence of Sebastopol (St. Petersburg, 1864) has been translated into several languages, and reviewed in a volume by William Howard Russell (London, 1864).

**TOFANA.** See AQUA TOFANA.

**TOGRUL BEG.** See SELJUKS.

**TOKAT,** or **Tocat,** a town of Asiatic Turkey, in the vilayet and 55 m. N. N. W. of the city of Sivas, on the Yeshil Irmak (the ancient Iris); pop. estimated variously from 45,000 to 150,000. It has high limestone hills on three sides, and is commanded by two peaks which are almost perpendicular and consist of crystalline marble. The houses are of mud or unburned bricks, but the town has a large and handsome Armenian church and several mosques. The manufactures consist chiefly of copper articles and hardware, woollen, linen, silk, cotton goods, and carpets; and there are dyeing and calico-printing establishments. The inhabitants are chiefly Turks.

**TOKAY** (Hun. *Tokaj*), a town of N. Hungary, in the county of Zemplén, at the junction of the rivers Bodrog and Theiss, 117 m. E. N. E. of Pesth; pop. in 1870, 5,012. Several important fairs are held here annually. Tokay is celebrated for the wine produced in its vicinity. (See HUNGARY, WINES OF.)

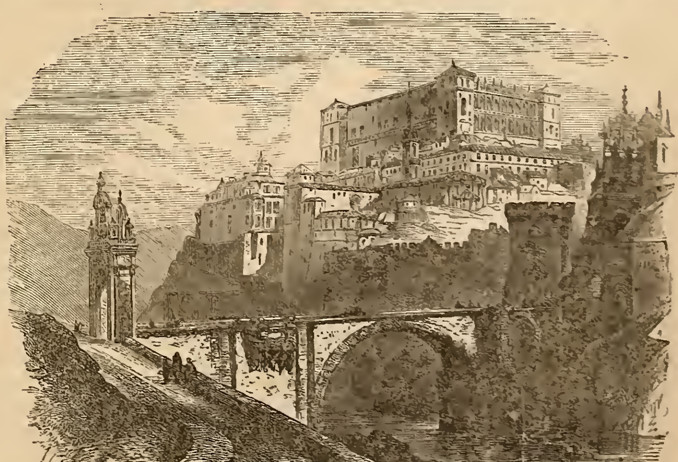
**TOKIO** (formerly YEDO), a city and the capital of Japan, in the E. part of the main island, at the head of the bay of Yedo, on the Sumidagawa, in lat. 35° 40′ N., lon. 139° 40′ E.; pop. in 1872, 779,361, including a garrison of 7,140 and 400 foreigners. The city is a combination of compactly built and densely inhabited districts, with intervening gardens and groves devoted to civil and religious uses, the whole covering nearly 60 sq. m., the area of the built up portion being about 28 sq. m., while one eighth of the whole is occupied by moats and canals. The centre of the city is the citadel, surrounded by stone walls and a moat, outside of which a second wall encloses about 3 sq. m. A third system of walls and moats encloses about 5 sq. m., formerly occupied by the residences of the daimios, but now covered with government buildings, colleges, schools, arsenals, barracks, founderies, steam mills, and factories. Outside, in the business and more densely populated portion, are miles of brick and stone buildings in the European style of architecture, and the shops are filled with foreign wares. The streets are wide, regular, and clean. The city is abundantly supplied with water brought in wooden aqueducts from the Tonegawa, 9 m. distant, and a part of it is lighted with gas. For police purposes it is divided into 6 principal and 96 smaller districts, with stations connected by telegraph and a uniformed force of 3,500 men. At the N. and S. ends of the city are the cemeteries, filled with tombs and temples. There are 741 Shinto shrines, 2,179 Buddhist temples, and 4 Christian churches. The imperial university has in its different faculties nearly 100 foreign instructors. The language, normal, and elementary schools are attended by more than 60,000 pupils. There are several banks, and more than a dozen daily newspapers printed with metal type on improved presses, and native capital has established cotton, woollen, and paper mills driven by steam, while sewing, knitting, and other manual machines are very common. Hundreds of horse vehicles and over 20,000 *jin-riki-sha* (man-power carriages) make the streets lively. Places of amusement abound; actors, wrestlers, story tellers, and female minstrels are numerous. Foreign dress and manner of living have been largely adopted, and the place presents most of the characteristics of a modern European or American city. It is connected by telegraph with Nagasaki, Hakodadi, and other cities. There is a railway to Yokohama, 18 m. distant, and a line has been surveyed to Kioto, 235 m. The shallow bay permits only junks and small steamboats to reach the city, and the foreign trade is limited.—Yedo was laid out in 1591, when the walls of the present stronghold were built, and it soon became the military centre of the empire. In 1656 and 1854 earthquakes occasioned an immense loss of life and property; and there have been many very destructive conflagrations, owing to the former combustible style of building and inefficient police. In 1861 the British and French legations were established here, but were soon driven away, and were not reëstablished till 1865. It 1862 it ceased to be the compulsory residence of the daimios. In 1868 it became the residence of the mikado, and the name was changed to Tokio ("eastern capital"). On Jan. 1, 1869, the port was formally opened to foreign trade and residence. In the summer of 1871 the entire power of the empire was centred here.

**TÖKÖLYI,** or **Tököli, Imre.** See HUNGARY, vol. ix., p. 58.

**TOLAND, John,** a British author, born near Londonderry, Ireland, in 1669 or 1670, died at Putney, near London, March 11, 1722. He studied three years at the University of Glas-

gow, received the degree of M. A. at the university of Edinburgh in 1690, studied two years for the ministry at Leyden, and finally became a conspicuous free thinker at Oxford. He went to Dublin in 1697, where the Irish parliament ordered the common hangman to burn his "Christianity not Mysterious" (London, 1696), and returning to London published "An Apology for Mr. Toland" (1697). He visited the courts of Hanover and Berlin, apparently as a political agent, and held a theological discussion with Beausobre. On returning to England, he professed himself in 1702 "a true Christian" and "a good churchman," but in 1705 declared himself a pantheist. He wrote political pamphlets for the earl of Oxford (Harley), by whom he was sent again in 1707 to Germany and Holland, as a political spy. Returning after three years, he was supported by Harley till a quarrel separated them. His other publications include "The Militia Reformed, or an Easy Scheme of Furnishing England with a constant Land Force" (1698); a "Life of Milton" (1698); editions of Lord Holles's "Memoirs" and of Harrington's "Works;" "Anglia Libera" (1701), a treatise on the succession of the crown of England; and "Nazarenus, or Jewish Gentile, or Mahometan Christianity, containing the History of the Ancient Gospel of Barnabas, and the Modern Gospel of the Mahometans, attributed to the same Apostle, this last Gospel being now first made known among Christians," &c., which involved him in controversies. His posthumous works were published with a biography by Des Maizeaux (2 vols., 1726; new ed., 1747).

**TOLEDO.** I. A central province of Spain, in New Castile, bordering on Ávila, Madrid, Cuenca, Ciudad Real, and Cáceres; area, 5,586 sq. m.; pop. in 1870, 342,272. The surface is generally mountainous, and there are elevated plains near the centre. The Tagus flows W. through the middle of the province. The Jigüela and its affluents flow toward the Guadiana. Gold, silver, lead, iron, copper, quicksilver, tin, cinnabar, alum, bismuth, coal, graphite, and ochre are found. The soil is generally poor, but in the centre and toward the south the quality improves. Grain, flax, fruit, vegetables, wine, oil, and silk are produced. But very few sheep, cattle, or horses are reared. II. A city (anc. *Toletum*), capital of the province, on the Tagus, 42 m. S. S. W. of Madrid; pop. about 18,000. It stands on a rocky height, around which the river in horseshoe shape flows in a deep and narrow channel, crossed by two stone bridges 100 ft. in height, one of which, built by the Moors, consists of a single arch. The town is encircled by two walls, originally Roman, but repaired and extended by Goths, Moors, and Spaniards, and entered by nine gates. The streets are steep, crooked, and narrow. The houses are generally in the Moorish style, from two to four stories high, with the apartments arranged round a court. The cathedral, in pure Gothic and with a lofty spire, founded in 1258 and completed in 1492, is one of the finest in Spain. The palace of the archbishop (who is the primate of Spain) formerly contained a rich collection of books and manuscripts, now added to the provincial library, which has 70,000 volumes. The foundling hospital of Santa Cruz, a fine piece of architecture, was founded by Cardinal Mendoza in 1494. The dilapidated walls of the ancient Alcázar are still standing. The university was suppressed in 1845; a seminary for theological students has been founded to supply its place; and there is a military school, a female college, school of fine arts, and other public schools. The principal manufactures are woollen and silk goods, oil, leather, and the celebrated Toledo blades, made in the royal sword manufactory two miles from the town. There is also a royal foundery outside the walls.—According to an ancient but improbable tradition, Toledo was founded by Jewish colonists in the 6th century B. C. It was taken by the Romans in 192 B. C., and by the Goths in A. D. 467, who made it the capital of their kingdom a century later. It was captured by the Moors in 714, and wrested from them by Alfonso VI. of Castile and Leon after a terrible siege in 1085, when it became the capital of Castile, and at one time had a population of 200,000. It afterward suffered many



The Alcázar of Toledo.

sieges, and the removal of the court to Madrid in 1560 led to its decline. It was occupied by the French from 1808 to 1813.

**TOLEDO,** a city and the capital of Lucas co., Ohio, port of entry of the district of Miami, on the Maumee river, 5 m. from its mouth in Maumee bay and 8 m. from the W. extremity of Lake Erie, 92 m. W. of Cleveland, and 53 m. S. S. W. of Detroit, Mich.; pop. in 1850, 3,829; in 1860, 13,768; in 1870, 31,584, of whom 11,099 were foreigners, including 5,341 Germans and 3,031 Irish; in 1875, estimated at 50,000. It comprises an area of 21·5 sq. m., of which 9·63 sq. m. were annexed in 1874; 6·2 sq. m. are on the E. side of the river and 15·3 sq. m. on the W. side. It has a fine harbor, and is well laid out, having wide streets that give an easy ascent from the harbor to the table land on which most of the houses are built. It has large and handsome public buildings, several small parks, street railroads, and water works recently erected. The number of miles of improved streets at the beginning of 1875 was 35·06; of sewers, 26·945; of water pipe, 41·62. Toledo communicates by the Miami and Erie canal with Cincinnati and Evansville, Ind., and has extensive railroad connections. The lines centring here are the Lake Shore and Michigan Southern, Toledo, Wabash, and Western, Dayton and Michigan, Detroit and Toledo, Flint and Père Marquette, Canada Southern, Columbus and Toledo, Toledo and Maumee, Toledo and Sylvania, and Toledo, Tiffin, and Eastern. All these railroads concentrate at an immense union depot. The chief items of receipt and shipment are grain and flour. There are 10 grain elevators, with a storage capacity of 4,017,000 bushels, and capacity to receive and ship 780,000 bushels daily. The aggregate deliveries of grain, including flour, for 14 years have been as follows:

| YEARS. | Bushels. | YEARS. | Bushels. |
|---|---|---|---|
| 1861........... | 18.593,565 | 1868........... | 16,141,990 |
| 1862........... | 21,518,063 | 1869........... | 18,660,949 |
| 1863........... | 14.326,459 | 1870........... | 23,714,510 |
| 1864........... | 14,103,993 | 1871........... | 35,300,220 |
| 1865........... | 12,857,240 | 1872........... | 35,527,285 |
| 1866........... | 11,595,835 | 1873........... | 34,349,877 |
| 1867........... | 13,131,905 | 1874........... | 39,304,891 |

The receipts in 1874 were 730,768 barrels of flour, 10,107,382 bushels of wheat, 17,031,996 of Indian corn, 6,460,247 of oats, 14,105 of rye, and 190,224 of barley. The shipments were 879,268 barrels of flour, 8,342,069 bushels of wheat, 16,801,345 of Indian corn, 6,381,372 of oats, 13,896 of rye, and 24,030 of barley. Other important items of receipt are provisions, live stock, whiskey, iron, tobacco, hides, cotton, wool, and lumber. In 1874 there were manufactured in the city 237,000 barrels of flour, 10,000,000 laths, and 30,000,000 ft. of lumber. The value of imports from Canada during the year ending June 30, 1874, was $79,018; of exports to Canada, $1,836,825; number of entrances, 302 of 69,517 tons; clearances, 286 of 71,389 tons; entrances in the coastwise trade, 1,962 of 441,593 tons; clearances, 1,918 of 425,951 tons; number of vessels belonging in the district, 170, with an aggregate tonnage of 13,946. The manufactories of Toledo include 5 flouring mills, 5 lumber mills, 6 iron founderies, a blast furnace, 5 breweries, 7 brick yards, 14 planing mills, 4 ship yards, 5 tanning and currying establishments, 2 manufactories of cars, 1 of car wheels, several of carriages and wagons, 2 of chairs, 1 of edge tools, 2 of files, 4 of lime, 1 of mowers and reapers, 3 of potash, 1 of refrigerators, 2 of coffee and spice mills, 3 of staves, 1 of stoves, 3 of tobacco, 2 of wire goods, 1 of wooden ware, and 2 of boots and shoes. There are six banks, with an aggregate capital of $1,900,000; three savings banks and several savings and loan associations, three fire and marine insurance companies, and one life insurance company.—The city is divided into eight wards, and is governed by a mayor, eight aldermen, and 16 councilmen. The principal charitable institutions are the city hospital, house of refuge and correction, home for friendless women, and three orphan asylums. There are 20 ward school houses and a high school building, with 122 teachers and about 7,500 pupils enrolled in 1874–'5, and 10 denominational and private schools. The public library contains 8,000 volumes. Three daily (one German), two tri-weekly, one semi-weekly, and six weekly (one German) newspapers, and six monthly periodicals are published. There are 45 churches, viz.: 3 Baptist, 1 Christian, 3 Congregational, 4 Episcopal, 2 Evangelical Association (German), 2 Evangelical Lutheran (German), 1 Evangelical Reformed (German), 2 Jewish, 3 Lutheran (German), 8 Methodist (2 German), 4 Presbyterian (1 German), 8 Roman Catholic (2 French and 2 German), 1 seamen's bethel, 1 Swedenborgian, 1 Unitarian, and 1 United Brethren.—Toledo was settled in 1832, and incorporated in 1836.

**TOLLAND,** a N. E. county of Connecticut, bordering on Massachusetts, drained by the Willimantic and Hop rivers; area, 440 sq. m.; pop. in 1870, 22,000. In the W. part the surface is nearly level and the soil fertile, but in the E. part it is very hilly and the soil inferior. It is intersected by the Hartford, Providence, and Fishkill, and Rockville branch, and the New London Northern railroads. The chief productions in 1870 were 15,860 bushels of rye, 101,721 of Indian corn, 76,574 of oats, 17,123 of buckwheat, 189,403 of potatoes, 531,399 lbs. of tobacco, 21,530 of wool, 386,763 of butter, 80,671 of cheese, and 40,320 tons of hay. There were 2,401 horses, 6,452 milch cows, 3,436 working oxen, 6,244 other cattle, 7,902 sheep, and 3,851 swine; 1 manufactory of leather belting and hose, 3 of boots and shoes, 5 of boxes, 12 of carriages and wagons, 23 of cotton goods, 2 of hosiery, 3 of iron castings, 8 of machinery, 9 of shoddy, 14 of silk goods,

24 of woollens, 2 bleaching and dyeing establishments, and 8 flour mills. Capital, Tolland.

**TOLLENS, Hendrik Corneliszoon**, a Dutch poet, born in Rotterdam, Sept. 24, 1780, died in Ryswick, Oct. 21, 1856. He was intended for trade, but in 1800 began publishing poetry, and finally became one of the most celebrated national bards. His masterpieces include a narrative poem on Barentz's expedition to Nova Zembla (new ed., 1844), dramatic works, and patriotic lyrics, especially the *Wapenkrect* (1815). His *Gezamentlijke dichtwerken* comprise 8 vols. (Leeuwarden, 1855–'7).

**TOLNA**, a S. W. county of Hungary, bordering on the counties of Veszprém, Stuhlweissenburg, Pesth, Baranya, and Somogy; area, 1,407 sq. m.; pop. in 1870, 220,740. It is watered by the Danube, which forms its E. frontier, and by the Sárvíz and Kapos. The soil is generally fertile, except the sandy E. portion. Corn, tobacco, flax, wine, and fruit are produced, and cattle, pigs, sheep, and horses abound. Capital, Szegszárd.

**TOLSTOI**, a Russian family, celebrated since the 17th century. Among its best known members at the present day are Count Alexis Tolstoi (born Sept. 5, 1817, died Oct. 10, 1875), a poet, novelist, and dramatist, author of three historical tragedies forming a trilogy, "Death of Ivan the Terrible," "Czar Feodor," and "Czar Boris," and Count Leo Tolstoi, whose novel of *Anna Karenina* (1875–'6) has given him a great reputation.

**TOLTECS**, or **Tulhuatecas**, a nation of Mexico, who according to Mexican annals appeared in Anahuac in the beginning of the 7th century, led in their wanderings from another continent or country by Tanub. They founded the kingdom of Tula, and were the first civilized and civilizing race. As they increased, capital arose at Colhuacan, Otompan, and Tollan. The Chichimecs, a nation of different origin, entered the country about a century later, and these were followed in time by seven Nahuatl tribes, of the same race as the Toltecs, the Mexicans being the last. Before this the Toltec monarchy, rent by civil wars between the clergy and nobles, had fallen in the 11th century; famine and pestilence desolated the country, and many of the survivors emigrated to Guatemala. The rest of the Toltecs were incorporated by the Chichimecs, to whom they imparted their civilization. The emigrants founded in Guatemala a new empire, and the Quichés claimed descent from them, though the names of the later Quiché monarchs show another language than the Toltec. It is usual to refer all that is grand or surprising in Mexico and adjoining parts to the Toltecs; but tradition ascribes to them definitely the use of hieroglyphics, astronomical knowledge and the division of time, agriculture, weaving, stone cutting, and architecture.

**TOLU, Balsam of.** See BALSAMS.

**TOLUCA**, a city of the republic, capital of the state, and 30 m. W. S. W. of the city of Mexico; pop. about 12,000. It is in a valley about 8,800 ft. above the sea, and has spacious, well paved streets, a public square, and several fine churches. Of late years its trade and industry have much declined. Near the town is the volcanic mountain of the same name, which rises to the height of 16,610 ft. above the sea.

**TOMATO**, a plant of the *solanaceæ* or nightshade family, cultivated for its fruit. It is a native of tropical or sub-tropical America, and its name, given in the earlier works as *tumatl* and *tomatl*, is of Indian origin. The plant was originally placed in the genus *lycopersicum*, which Linnæus reduced to *solanum*; but later botanists, thinking that the difference in the anthers, which are united at the tips and open by a longitudinal slit, and not by a pore at the apex as in *solanum*, was a sufficient distinction, restored the genus, and call the tomato *lycopersicum esculentum*; while some still adhere to the view of Linnæus, and class the plant as *solanum lycopersicum*. The older English writers call the fruit love apple; in France *pomme d'amour*, and in Italy *pomi d'amore*, are still in use, perpetuating the old notion that their use as food had an influence upon the passions. Peru is regarded as its native country, but it has not been found there or elsewhere in a truly wild state, and it had probably been long in cultivation before the advent of the Europeans. The tomato has weak stems about 4 ft. long, and when left to itself forms a much branched trailing or prostrate plant. Its leaves are irregularly pinnate, with the larger leaflets themselves cut or divided; both stem and leaves are clothed with soft viscid hairs, which exude a strong-smelling, rather fetid, and somewhat resinous sub-


Varieties of the Tomato.—1. Common Red. 2. The "Trophy." 3. Pear-shaped. 4. Currant Tomato.

stance, which stains the hands and clothing when the plants are handled. It has been lately said that an infusion of tomato leaves is effective in destroying plant lice. The flower stalks, or peduncles, are extra-axillary and bear

racemose clusters of yellow flowers, which, with the exception in the anthers already noted, have a similar structure to those of the solanums. (See SOLANUM.) The fruit is normally a two- or three-celled berry, but in the cultivated plant there are usually numerous cells; the fruit, especially in the larger specimens, often has a very complicated structure, resulting from the union of two or more flowers; their pistils being fused together present at maturity a curiously abnormal fruit, in which all traces of the original structure are lost. The cultivated tomatoes present a great variety in form, color, and size, and it is not known whether they are from several species or are different forms of one very variable species. The plant is remarkably plastic, and by selecting seeds from fruit with desirable peculiarities, it is very easy to establish a strain or variety. When tomatoes were first cultivated in our gardens there was but one variety; this had a

Tree-formed Tomato.

large, red, much wrinkled, and often irregular and misshapen fruit, with a thick outer wall, and a central placenta bearing the seeds surrounded by their pulp, and a considerable cavity or empty space between the two. By selection this was improved as to its surface, and greater solidity acquired, and the strain known as the smooth red was obtained, which is still one of the best. The variety known as the "Trophy" probably combines more good qualities than any other; it has very large and smooth fruit, which is solid throughout, and of the best possible quality; this is the result of 20 years' careful selection by an intelligent grower, with a definite end in view. Many attempts have been made to increase the earliness of the fruit, but improvement in this direction is limited by the law that every plant needs a certain aggregate amount of heat to bring it to maturity; the varieties "Conqueror" and "Canada Victor" have apparently reached this limit. Among the very distinct varieties is the "Feejee," which has a large rose or pinkish red fruit; there are several yellow varieties and one nearly white large one, and there are both yellow and red of smaller sorts named according to the shape and size of the fruit, such as the pear, plum, and cherry tomatoes; the currant tomato, which has berries scarcely larger than a large currant, in long racemes, and delicate foliage, is very ornamental, and apparently a distinct species, probably *L. cerasiforme.* The upright or tree tomato originated in France; its main stem is thick, and its few branches so short and strong that it carries its weight of large fruit without support; but it is not very productive. Less than half a century ago the tomato was almost unknown to northern gardens, or cultivated in them only as a curiosity, but at present it is one of the most popular of vegetables. As the fruit will color and ripen when picked green, it can be transported to great distances, if properly packed in small crates with abundant openings for ventilation; the first tomatoes in the northern markets come from Bermuda, appearing in February, followed successively by contributions from Florida, Georgia, &c., before the fruit from the gardens near by is ripe. At the north the seeds are sown in hot-beds, the young plants set out in other hot-beds, and finally transplanted to cold frames, where they may be protected at night until the weather is warm enough to set them in the open ground. Light, well manured soils are better than heavy ones for this crop; in field culture the plants soon fall over with the weight of fruit and are allowed to lie upon the ground, but in private gardens they are supported by a frame or trellis, or tacked up to a fence or the side of a building; by proper pruning and removing the excess of young fruit, the size and quality of that allowed to ripen is greatly improved.—The tomato is used in a great variety of ways, being eaten raw as a salad, stewed, baked, broiled, and as an ingredient of soups, stews, and sauces; it is used to make a popular catsup, and is pickled and preserved in various ways.—The strawberry tomato is described under PHYSALIS.

**TOMBIGBEE, Tombigby,** or **Tombeckbee,** a river of Mississippi and Alabama, which rises in Tishomingo co. in the N. E. extremity of the former state. It first flows S. to Columbus, thence S. E. to Demopolis, Ala., where it receives the Black Warrior on the left, and thence generally S., with many and sudden windings, to its junction with the Alabama, about 45 m. from Mobile, where the united stream takes the name of Mobile river, and falls into Mobile bay about 30 m. from the gulf of Mexico. Its length is estimated at 450 m., and it is navigable for large steamboats to Columbus, 366 m. from the mouth of Mobile river.

**TOM GREEN,** a S. W. county of Texas, formed in 1874; area, about 14,000 sq. m. It is bounded S. W. by the Pecos river and N. W. by New Mexico. In the east it is intersect-

ed by the head streams of the Colorado river. This county, with Crockett, formed in 1875, has absorbed what was formerly known as Bexar district or territory. Capital, Ben Ficklin.

**TOMLINE, George,** an English prelate, eldest son of George Pretyman, born in Bury St. Edmunds, Oct. 9, 1750, died in Winchester, Nov. 14, 1827. He was educated at Cambridge, and in 1773 became tutor to William Pitt, who made him his private secretary on becoming chancellor of the exchequer in 1782, and his secretary when he became first lord of the treasury. Pretyman remained with Pitt till 1787, when he was made bishop of Lincoln and dean of St. Paul's. In 1820 he was transferred to the see of Winchester. In 1803 he received by will an estate from Marmaduke Tomline, and assumed that name. He published "The Elements of Christian Theology" (2 vols. 8vo, 1799), which has passed through numerous editions; "A Refutation of Calvinism" (1811); and "Memoirs of William Pitt" (3 vols. 8vo, 1821), "which," Macaulay says, "enjoys the distinction of being the worst biographical work of its size in the world."

**TOMMASEO, Nicolò,** an Italian author, born in Sebenico, Dalmatia, about 1803, died in Florence, May 1, 1874. He resided several years in Florence, wrote for the patriotic *Antologia*, went as an exile to France in 1833, and in 1838 settled in Venice. He was arrested with Manin in January, 1848, but they were rescued in March by the people, and in August Tommaseo became minister of religion and education in the revolutionary government, and vainly attempted to procure French intervention in favor of the republic. After the restoration of Austrian rule in August, 1849, he was banished from Venice, resided in Corfu and Turin, and in 1865 finally returned to Florence. His works include *Nuovo dizionario dei sinonimi della lingua italiana* (Florence, 1832; 5th ed., 2 vols., Milan, 1867); *Canti populari* (2 vols., Venice, 1843); *Studi critici* (2 vols., 1843); *Lettere di Pasquale de' Paoli*, with Paoli's biography and a history of the war for Corsican independence (Florence, 1846); *Nuovi studi su Dante* (Turin, 1865); and *Poesie* (1872).

**TOMOMI IWAKURA,** a Japanese statesman, born in Kioto about 1825. He is a *kuge* or court noble of the Murakami branch of the Minamoto family, and was a leader as well as the instrument of the conspiracy which effected the Kioto *coup d'état* of Jan. 3, 1868, overthrowing the shogunate, and establishing a government in which his class held the chief offices. (See JAPAN, vol. ix., p. 546.) In August, 1871, he was made minister of foreign affairs, and was active in the abolition of the feudal system and the retirement of the ex-daimios to private life. In December he left Japan as chief of the embassy which visited the United States and the principal capitals of Europe. On his return in September, 1873, he was made junior prime minister, which office he now holds (1876). He was active in averting the threatened war with Corea in 1873. He has been especially distinguished for his advocacy of the introduction of the forms and improvements of western civilization, and he sent his sons to the United States to be educated. On the night of Jan. 14, 1874, while he was in his carriage near the mikado's palace, an attempt was made to assassinate him, but he escaped with several severe wounds.

**TOMPKINS,** a central county of New York, drained by several tributaries of Cayuga lake, the head of which lies in the N. part, and traversed by several railroads; area, 506 sq. m.; pop. in 1875, 32,915. The surface is hilly, the valley of the lake being 700 ft. below the ridges on either side, and the soil is generally best adapted to grazing. Cayuga lake supplies water communication with the Erie canal. The chief productions in 1870 were 291,194 bushels of wheat, 422,411 of Indian corn, 737,741 of oats, 236,183 of barley, 143,917 of buckwheat, 273,941 of potatoes, 63,681 lbs. of tobacco, 169,867 of wool, 62,390 of flax, 1,834,029 of butter, and 70,907 tons of hay. There were 8,804 horses, 16,402 milch cows, 11,369 other cattle, 35,372 sheep, and 7,462 swine; 11 manufactories of agricultural implements, 24 of carriages and wagons, 1 of cars, 7 of cheese, 1 of clocks, 12 of furniture, 3 of hubs and wagon material, 7 of iron castings, 4 of machinery, 1 of organs, 2 of printing paper, 6 of tobacco and cigars, 4 of woollens, 26 flour mills, 19 saw mills, 8 tanneries, and 5 currying establishments. Capital, Ithaca.

**TOMPKINS, Daniel D.,** an American statesman, born at Scarsdale, Westchester co., N. Y., June 21, 1774, died on Staten island, June 11, 1825. He graduated at Columbia college in 1795, was admitted to the bar in New York in 1797, and in 1801 was a member of the legislature, and of the convention for revising the state constitution. In 1804 he was elected to congress from the city of New York, but resigned to become one of the associate justices of the supreme court of the state. From 1807 to 1817 he was governor of New York, and he was conspicuous for his support of the national government during the war of 1812. In 1812 he prorogued the legislature for ten months, to prevent the establishment of the bank of America in the city of New York. This measure gave him temporary popularity, but did not defeat the charter of the bank, which was passed in 1813. In a special message to the legislature, Jan. 28, 1817, he recommended the abolition of slavery in the state of New York; and an act for that purpose was accordingly passed, to take effect July 4, 1827. In 1816 he was elected vice president of the United States, and in 1817 resigned the governorship on assuming that office, to which he was reëlected in 1820, retiring March 4, 1825.

**TOMSK. I.** A government of western Siberia, bordering on Tobolsk, Yeniseisk, China, and the Central Asian provinces of Semipolatinsk and Akmolinsk, from which it is partly sepa-

rated by the Irtish; area, 329,027 sq. m.; pop. in 1870, 838,756. The Altai mountains extend along the S. part. The river Obi rises in the south, flows N., and receives numerous tributaries, the chief of which are the Tchumish, Tom, Tchulim, and Ket. There are several lakes. Gold, silver, copper, lead, and iron are extensively worked in the south. The N. part is barren, but toward the south the pastures become luxuriant, and abundant crops are raised; but cattle constitute the principal wealth. **II.** A city, capital of the government, on the right bank of the Tom, 620 m. E. S. E. of Tobolsk; pop. in 1867, 24,431. It consists of an upper town inhabited by the wealthy classes, chiefly Russians, and a lower town, by Tartars and Bokharians. It has many fine private and public buildings. In 1875 provisions were made for a Siberian university here. The chief trade is in grain, leather, and furs. Situated on the great road leading to the Chinese border, it is next to Irkutsk the most prosperous town of Siberia. It was founded about 1610.

**TON,** or **Tun,** a denomination of weight, equal to 20 cwt. or 2,240 lbs., and also (usually with the second orthography) a liquid measure of 252 gallons; also applied to dry measures and solid measures of various capacities in different countries. In common use, the ton weight is often rated at 2,000 lbs., when it is termed the "short ton;" but by act of congress, when not specified to the contrary, the ton is to be understood as 2,240 lbs. In Maryland the ordinary ton is 2,000 lbs., the usual coal ton 2,240 lbs., and the miner's ton, according to which he is paid, is 2,470 lbs., the allowance being for waste. The shipping ton of France was by the old standard 2,158·43 lbs., and the metrical ton is 2,204·6 lbs.; the shipping ton of Spain is 2,032·2 lbs.; of Portugal, 1,755·8 lbs. The measurement ton for shipping is in the United States 40 cubic ft. In England the tun for wine is 252 gallons.

**TONE, Theobald Wolfe,** an Irish revolutionist, born in Dublin, June 20, 1763, died in prison there, Nov. 19, 1798. He graduated at Trinity college, Dublin, and was called to the bar in London in 1789. In defence of the whig club he published "A Review of the Last Session of Parliament" in pamphlet form, and on the appearance of a rupture with Spain wrote a pamphlet to prove that Ireland as an independent nation was not bound by a declaration of war. Subsequently he sought to effect a union against the government between the Catholics of Ireland and the dissenters, and in 1791 addressed to the latter "An Argument on behalf of the Catholics of Ireland." The same year he assisted in founding the first club of "United Irishmen" at Belfast, and others in other parts of Ireland. He became secretary and agent of the Catholic committee in 1792, and was subsequently implicated in the proceedings of Jackson, sent from France to sound the sentiments of the Irish. He was allowed to retire from the country, and in 1795 came to the United States. Letters asserting that Ireland was ripe for a revolt induced him to sail for France in January, 1796, to gain the aid of the directory; and owing in large measure to his exertions, that government determined to fit out a powerful expedition under the command of Hoche. In July Tone received his commission as *chef de brigade*, and was also made an adjutant general to Hoche, whom he accompanied in December in the armament destined for Bantry bay. The fleet was scattered by storms, and the French government would not undertake another expedition. In 1797 Tone was attached to Moreau's army; and in September, 1798, he accompanied a petty squadron destined for Ireland, which was intercepted and defeated by an English squadron. After fighting desperately, Tone was captured, carried to Dublin, tried by court martial, and sentenced to be hanged on Nov. 12. He died, however by his own hand, having cut his throat with a penknife on the 11th. After his death appeared "The Life of Theobald Wolfe Tone, written by himself, with his Political Writings," &c., edited by his son William Theobald Wolfe Tone (including "An Account of his own Campaigns under Napoleon," 2 vols. 8vo, Washington, 1826; abridged, London, 1827, 1837, and 1847).—His son was an officer in the French army, and after the fall of Napoleon in that of the United States; and he was also the author of *L'État civil et politique de l'Italie sous la domination des Goths* (Paris, 1813), and "School of Cavalry" (Georgetown, D. C., 1833).

**TONGATABOO.** See Friendly Islands.

**TONGUE,** in the animal system, the organ, situated on the median line, at the commencement of the alimentary canal, ministering to the senses of touch and taste. Taking the tongue of man as an example, the organ is attached at its base to the movable hyoid arch of bones, and suspended and kept in place by muscles from the base of the skull, lower jaw, and hyoid bone; it is essentially composed of muscular fibres, which move freely its various portions; it is covered by sensitive mucous membrane, containing numerous mucous glands and follicles; fibrous, areolar, and fatty tissues enter into its structure, which is freely supplied with blood vessels and nerves. The size bears no relation to the height of the individual, but is proportioned to the capacity of the alveolar arch; it is, therefore, smaller in women than in men. From the base to the epiglottis extends a fold serving to limit the movements of the latter organ, and from the sides of the base to the soft palate two folds on each side, the pillars of the fauces, between which are the tonsils; under the anterior free extremity is the frenum, which connects it with the lower jaw, a fibrous and mucous lamina or ligament, sometimes so short congenitally as to prevent the free movements of the tongue and to require an operation for its division. There

is a more or less distinct longitudinal furrow on the median line, from which extend outward and forward numerous other lines whose angle of union points backward; the posterior third is smooth and without compound papillæ, exhibiting a few simple ones and the nodular eminences of the numerous muciparous glands; in front of this is a V-shaped ridge, the angle directed backward, formed by two converging lines of button-like eminences, the circumvallate papillæ; in front of these, and occupying the anterior two thirds of the organ, are the fungiform and conical or villiform papillæ, the former spheroidal and scattered, the latter very numerous. The osseous support of the tongue is the U-shaped or hyoid bone, consisting of a base or median body, two greater and two lesser cornua, and placed in the neck between the lower jaw and the thyroid cartilage; it is the homologue of a very complex apparatus in the lower vertebrates. The muscles constitute the chief bulk of the tongue; they are arranged in a complicated manner, so as to support each other, rendering the movements of the organ exceedingly varied and extensive; they are attached to the submucous fibrous tissue, which is firm and thick on the superior surface. The mucous membrane is invested with a delicate scaly epithelium, the superficial layer of which readily and constantly falls off. The papillæ are much like those of the skin, most being compound organs, in their nervous and vascular supply. The circumvallate papillæ are 6 to 10 in number, and sometimes $\frac{1}{8}$ in. in diameter; the fungiform are $\frac{1}{20}$ to $\frac{1}{50}$ in. in diameter, and vary greatly in number, perhaps accounting for the well known diversity in the acuteness of the sense of taste in different individuals; the filiform are the most numerous, closely set like the pile of velvet, covering the anterior two thirds of the tongue, and the seat of what is called the fur; their epithelium frequently breaks up into hair-like processes, having their imbrications directed backward, which mark a physiological distinction between the circumvallate and fungiform papillæ and the filiform and conical ones. The conical papillæ are generally regarded as tactile, the fungiform and circumvallate as gustatory (acutely tactile), and the filiform as the homologues of the recurved spines of the tongue of the cats, and as principally concerned in regulating the movements of the food in order to bring it within the reach of the muscles of deglutition. The principal arteries of the tongue are the lingual branches of the external carotid; the sensory nerves are the lingual branch of the fifth pair or trifacial and the glossopharyngeal, distributed respectively to the anterior and posterior portions, and the motor nerve is the hypoglossal; for their functions see TASTE. The tongue in fishes is rudimentary, and not endowed with any great sensibility or motor power; in reptiles it varies greatly in length, size, and movability, being in some immovable or short and thick, in some remarkable for slenderness and length (as in serpents), and in others for protractility (as in the chameleon and frog); in them it is usually an organ of prehension and not of sensation. The tongue in birds is also prehensile and not gustatory, and generally

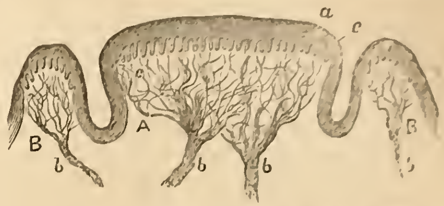



FIG. 1.—Papilla circumvallata of Man, in transverse and vertical section. A. Proper papilla. B. Wall. *a*. Epithelium. *c*. Secondary papillæ. *b, b*. Nerves of the papilla and of the wall. (Magnified about 10 diameters.)

provided at the base with numerous spines directed backward to prevent the return of food; though itself incapable of elongation, it may be remarkably protruded by the action of the muscles attached to the very long and movable hyoid bones. In some mammals, as the giraffe and ant-eater, it is capable of great elongation, and is an important organ of prehension; the recurved spines of the cats have been referred to, and constitute efficient instruments for cleaning flesh from bones and for combing their fur. In man the tongue keeps the food during mastication within the range of the teeth, collects it from all parts of the mouth preparatory to swallowing it, and is also concerned in the commencement of deglutition; and it is a principal organ of articulation. It is liable to inflammation, enlargement, atrophy, ulcerations, tumors, and malignant diseases. The fur in disease depends on a sodden and opaque condition of the epithelium of the filiform and conical papillæ, arising from an alteration of the mucus and

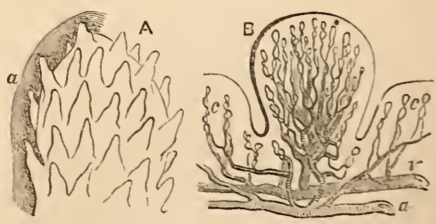
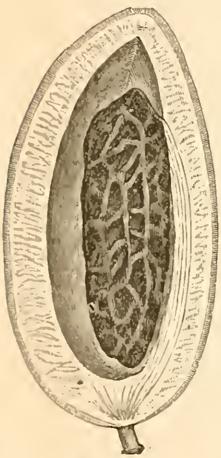



FIG. 2.—A. Fungiform Papilla, showing the secondary papillæ on its surface, and at *a* its epithelium covering them over. (Magnified 25 diameters.) B. The capillary loops of the simple papillæ of A, injected: *a*, artery; *v*, vein. The groove around the base of some of the fungiform papillæ is represented, as well as the capillary loops (*c, c*) of some neighboring simple papillæ. (Magnified 18 diameters.)

saliva of the mouth, the bright red color of the fungiform papillæ presenting a striking contrast; the amount, color, and arrangement of the fur are symptomatic of various morbid changes in the system, of interest to the physician, though there is great variety within the

limits of health. The papillary surface is healed and repaired with great readiness and perfection.

**TONQUA BEAN** (also written Tonquin, Tonga, and Tonka), an Asiatic name applied to a South American product, the seeds of *dipterix odorata*, a tree belonging to the *leguminosæ* or pulse family. The genus *dipterix* (Gr. δίς, double, and πτερόν, a wing) comprises about eight species, all large trees of the forests of Brazil, Guiana, and neighboring countries, and belongs to a tribe of the family of which there are no representatives in northern localities; the trees have pinnate leaves and large panicles of flowers, which are succeeded by (what is very unusual in the family) a pod containing only a single seed. The Tonqua bean tree grows 60 to 90 ft. high, with a trunk sometimes 3 ft. in diameter; the indehiscent pods, about 2 in. long, are almond-shaped and very thick; the single seed is over an inch long, shaped somewhat like a large kidney bean; it has a wrinkled skin, which is shiny black. The odor, which is remarkably strong, resembles that of the melilot or sweet clover and the sweet-scented vernal grass (*anthoxanthum*), and is due to the same principle, coumarine, a concrete crystallizable, volatile, neutral substance, with the composition $C_{18}H_6O_4$, very soluble in alcohol and ether, and somewhat so in boiling water, from which it crystallizes on cooling; the beans are often frosted with crystals of this, which show very distinctly on their black surface. Formerly the beans were much used to scent snuff, and they are often called "snuff beans," a few of them being placed in a jar with the snuff, or a single one kept in the snuff box; they were also formerly used in smoking tobacco, but a much cheaper substitute is found in the "wild vanilla" (*liatris odoratissima*) of Florida. (See VANILLA.) The odor of the bean bears some resemblance to that of the true vanilla, and much of the extract of vanilla sold for flavoring ice cream and articles of cookery is adulterated with it, and in some of the cheaper flavoring extracts it is entirely substituted for that costly material; any one with a nice sense of smell can readily detect the least admixture. The wood of the Tonqua bean tree is remarkably close-grained, hard, and heavy, and, though redder, much resembles lignumvitæ, and in some parts of South America it is called by that name; it is valued for fine cabinet work. Another species, *D. eboënsis*, is the eboe tree, the fruit of which is without odor; its timber is hard and valuable.



Tonqua Bean (Dipterix odorata). Half of the one-seeded pod.

**TONQUIN.** See ANAM.

**TONQUIN, Gulf of**, an arm of the China sea, having the Anamese province of Tonquin on the west, the Chinese province of Quang-tung on the north and east, and the island of Hainan on the southeast; length, nearly 300 m.; average width, 150 m. The Sangkoi or Tonquin river flows into it. It has numerous islands. The typhoons are very violent in the gulf.

**TONSILS**, or **Amygdalæ**, two glandular organs, of an almond shape, with the larger end upward, situated on each side of the fauces, between the anterior and posterior pillars of the soft palate, and easily brought into view by opening the mouth. They are composed of a collection of mucous follicles, which open through 12 or 15 orifices on the inner side of each tonsil. These follicles are lined with a continuation of the mucous membrane of the pharynx, and have a structure similar to that of Peyer's glands in the small intestine. They secrete mucus which goes to make up the mixed mass of saliva, or to lubricate the fauces during the act of deglutition, the pressure of the food and the constriction of the pharynx forcing the contents from the organs. They are supplied with blood from the facial, inferior pharyngeal, and internal maxillary arteries, and with nerves from the fifth and glosso-pharyngeal. The veins terminate in the tonsillar plexus on the outer side of the tonsil. These organs vary in size in different individuals, being notably larger in persons of scrofulous constitution. They are liable to acute inflammation, involving great enlargement and suppuration; an affection called tonsillitis or cynanche tonsillaris, and popularly quinsy.

**TONSTALL.** See TUNSTALL.

**TONTINE**, a kind of life annuity originated by Lorenzo Tonti, a Neapolitan, who published his scheme and introduced it into France about the middle of the 17th century. The subscribers or their representatives were divided into 10 classes, and an annuity was apportioned to each class according to their age, the survivors deriving an increased annuity as their associates died, and the last survivor receiving the entire annuity of the class till the close of his life. The first association of this kind, called the "Royal Tontine," was founded under the administration of Cardinal Mazarin in 1653. The total sum paid in was 1,025,000 francs, in 10 classes of 102,500 francs each. The subscription was 300 francs, and every subscriber received the interest of his investment until the death of some member of the association increased the dividend to the rest, and after the death of the last subscriber it reverted to the state. This project was not successful, nor were two more subsequently proposed by Tonti. In 1689 Louis XIV. authorized another of 1,400,000 francs divided into 14 classes, according to age, from children of 5 years to

adults of 70. In 1726 the last survivor of the 13th and 14th classes was the widow of a poor surgeon who had invested 300 francs in two tontines, and who enjoyed at her death, at the age of 96, an income of 73,500 francs. Tontines were again resorted to by the French government in 1733 and 1734; but in 1763 they were interdicted as a measure of finance. In 1791 a tontine called the *caisse Lafarge*, on a more extended scale, was established under private management; but by a gross blunder or fraud, the interest promised was impossible, and the subscribers, whose united contributions amounted to 60,000,000 francs, never received even simple interest, and the entire capital was lost in the disasters of the time. In England tontines have been occasionally resorted to as a measure of finance, the last opened being in 1789, and a few private ones have been established. In 1871 the Alexandra park company in London proposed to organize an institution similar to the South Kensington museum by means of a tontine to cease June 30, 1886; but the scheme proved unsuccessful, and was abandoned in 1872. In the United States there have been private annuities of this kind. The New York tontine association was organized in 1790, with 203 shares valued at $250 each. The tontine coffee house was built in Wall street, and about 1850 the property was leased for business purposes. The lease was to expire and the property to revert to the owners of the shares depending upon the last seven surviving lives. This contingency occurred in 1870, but proceedings for winding up the affairs of the association and the partition of the property are still pending (1876). Buildings have been erected in some other cities on the same plan.

**TONTY, Henry de,** an Italian explorer, died at Fort Louis, Mobile, in September, 1704. The son of Lorenzo Tonti, inventor of the tontine system of association, he entered the French army as a cadet, served in the navy, and lost a hand. He came to Canada with La Salle in 1678. Near the present site of Peoria on the Illinois river he assisted in building a fort in 1680, which La Salle left in his command. He attempted a white settlement in Arkansas. In 1685 he brought a force of western Indians to join in attacking the Senecas. Twice he went to meet La Salle at the mouth of the Mississippi, but without finding him. He descended a third time to meet Iberville, and remained in the gulf region. His memoir of La Salle's voyage, published in Margry's *Relations et mémoires*, has been translated into English under the title "Account of M. de la Salle's last Expedition and Discoveries in North America" (12mo, London, 1698; 8vo, New York, 1814; in French's "Historical Collections of Louisiana," vol. i., 1846).

**TOOELE,** a W. county of Utah, bordering on Nevada, and bounded N. E. by Great Salt lake; area, 8,320 sq. m.; pop. in 1870, 2,177. The greater portion is a barren desert. The hilly portions contain some valuable arable and grazing land, and mines of gold, silver, copper, and lead. In the W. part are large fertile valleys and several mining districts. The chief productions in 1870 were 23,483 bushels of wheat, 2,505 of Indian corn, 2,840 of oats, 1,630 of barley, 9,848 of potatoes, 8,497 lbs. of wool, and 973 tons of hay. There were 511 horses, 2,041 cattle, 4,929 sheep, and 121 swine; 1 flour mill, and 2 saw mills. Capital, Tooele.

**TOOKE, John Horne,** an English politician, born in Westminster, June 25, 1736, died at Wimbledon, March 18, 1812. He was the son of John Horne, a poulterer, was educated at Cambridge, became an usher in a school at Blackheath, took orders, and obtained a curacy in Kent. He was ordained priest in 1760, and for three years officiated in the chapelry of New Brentford. He then went to France as travelling tutor to the son of Elwes the miser. In 1765 he wrote a pamphlet in favor of Wilkes and his party; and on a second visit to the continent he formed at Paris an intimate acquaintance with that politician. On his return in 1767 he took an active interest in political matters, especially in securing the election of Wilkes from Middlesex. In 1769 he was one of the founders of the society for supporting the bill of rights; but its financial affairs involved him in a quarrel with Wilkes, and for this he was attacked by Junius, but defended himself with success. In 1771 he received his degree of M. A. from the university of Cambridge. In 1773, designing to study law, he formally resigned his living. He rendered great assistance in resisting an enclosure bill which would have reduced the value of some property of his friend William Tooke of Purley, who in return made him his heir; but, though in 1782 he changed his name to Tooke, he never received more than £8,000 from the property. He bitterly opposed the American war, and advertised for a subscription for the widows and orphans of the Americans "murdered by the king's troops at Lexington and at Concord." The ministry prosecuted him for libel, and he was tried at Guildhall in July, 1777. He conducted his own defence, but was condemned to one year's imprisonment and a fine of £200. While confined he published his celebrated "Letter to Mr. Dunning," critically explaining the case of The King *v.* Lawley, which had been used as a precedent against him on his trial. He declared himself "the victim of two prepositions and a conjunction," which particles he calls "the abject instruments of his civil extinction." After his release in 1779, he applied for admission to the bar, but was rejected on the ground of being a clergyman. He published in 1780, in conjunction with Dr. Price, a pamphlet entitled "Facts," severely reflecting upon Lord North and his prosecution of the American war. In 1786 appeared the first part of his "Ἔπεα πτερόεντα, or the Diversions of Purley," the object of which

was to prove that all parts of speech could be resolved into nouns and verbs, and that all words were at first applied to sensible objects. The second part appeared in 1805 (new ed. by Richard Taylor, with additions from the copy prepared by the author for republication, and his letter to John Dunning, 2 vols. 8vo, 1829; with additional notes by Richard Taylor, 8vo, 1860). In 1787 he published "A Letter to the Prince of Wales" in regard to his supposed marriage with a Roman Catholic. In 1788 appeared his pamphlet "Two Pair of Portraits," in which he drew a contrast between the two Pitts and the two Foxes. In 1794 he was tried for high treason, with Hardy, Thelwall, and others, mainly on the ground of his participation in the action of the "Constitutional Society," and was acquitted, being eloquently defended by Erskine. In 1801 he was returned to the house of commons by Lord Camelford for the borough of Old Sarum, and he retained his seat till the dissolution in 1802; but the decision of that parliament that no one in priest's orders could be a member disqualified him from sitting again. The latter years of his life were spent at Wimbledon. He was never married, but left several illegitimate children.—See "Memoirs of John Horne Tooke, interspersed with Original Documents," by A. Stephens (2 vols. 8vo, 1813), and "Memoirs of John Horne Tooke, Esq., together with his Valuable Speeches and Writings," &c., by John A. Graham (New York, 1828).

**TOOKE. I. William**, an English clergyman, born Jan. 18, 1744, died in London, Nov. 17, 1820. In 1771 he became minister of the English church at Cronstadt, and in 1774 chaplain to the factory of the Russian company at St. Petersburg, where he remained till 1792. His most important works are: "Russia, or a Complete Historical Account of all the Nations which compose the Russian Empire" (4 vols. 8vo, 1780–'83; French translation, Paris, 1801); "Life of Catharine II., Empress of Russia," an enlarged translation from the French (3 vols., 1797–1800; new ed., 1810); "A View of the Russian Empire during the Reign of Catharine II. and to the Close of the Eighteenth Century" (3 vols., 1799); and "History of Russia, A. D. 862–1762" (2 vols., 1800–'6). **II. Thomas**, an English political economist, son of the preceding, born in St. Petersburg in 1774, died in London, Feb. 26, 1858. In 1838 he published "A History of Prices and of the State of the Circulation from 1793 to 1837, preceded by a brief Sketch of the State of the Corn Trade in the last two Centuries" (2 vols. 8vo). Four additional volumes bring the work down to 1856.

**TOOLE, John Lawrence.** See p. 909.

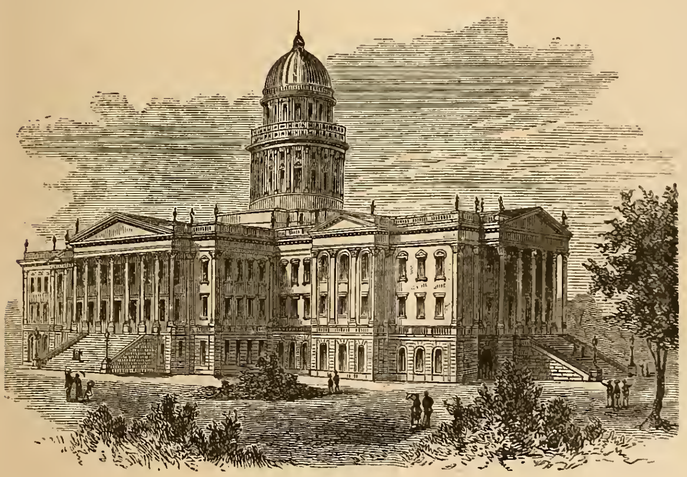
**TOOMBS, Robert**, an American politician, born in Washington, Wilkes co., Ga., July 2, 1810. He graduated at Union college, Schenectady, in 1828, studied law at the university of Virginia, and began practice in his native place. In 1836 he served in the Creek war. In 1837 he was elected to the state legislature, and with the exception of 1841 continued a member till 1845. He was a member of congress from 1845 to 1853, when he was elected a member of the United States senate, and was reëlected for the term ending March 4, 1865. He was a prominent member of the extreme southern party, and after the election of President Lincoln was one of the most active in persuading Georgia to secede. The state of Georgia having passed its secession ordinance on Jan. 19, 1861, Mr. Toombs withdrew from the senate on the 23d, and on March 14 he was expelled. He was a member of the confederate congress which met at Montgomery, Ala., was subsequently for a short time secretary of state of the Confederate States, and also served as a brigadier general in the confederate army.

**TOORKISTAN.** See Turkistan.

**TOPAZ**, a precious stone, a silico-fluoride of alumina, consisting, in 100 parts, of alumina 48 to 58, silica 34 to 39, and fluorine 15 to 18·5. Its specific gravity is 3·4 to 3·65; its hardness is 8, or between that of quartz and sapphire. It is usually colorless, but is sometimes blue, green, or red. The yellow Brazilian topaz when heated becomes reddish, while the Saxon wine-colored topaz loses its color entirely. Topaz is pyro-electric; it crystallizes in the trimetric or rhombic system, the prism generally having dissimilar extremities. When heated in the blowpipe flame it becomes covered with small blisters, while a coarse variety called physalite (Gr. φύσειν, to blow) swells up when heated. Its principal localities are: the Ural and Altai mountains, Kamtchatka, Villa Rica in Brazil (of a deep yellow color), Altenberg in Saxony, and the Mourne mountains in Ireland; in the United States, at Trumbull and Middletown, Conn., and at Crowder's mountain, N. C. Physalite is found in Norway and Sweden in very large crystals; one weighed 80 lbs. The topaz is not very highly valued as a gem, though fine specimens sometimes bring very good prices. Tavernier speaks of one belonging to the Great Mogul weighing 157 carats, which was valued at 181,000 rupees. The principal supply is from Brazil, which furnishes about 40 lbs. annually. The white and rose-red are the most valuable. The former are called by the Portuguese *pingas d'agoa* (drops of water), and when cut resemble the diamond in brilliancy. The oriental topaz is the yellow variety of transparent corundum, and belongs to the family of sapphires. (See Sapphire.) A yellow variety of quartz is sometimes called false topaz.

**TOPEKA**, a city and the capital of Kansas, county seat of Shawnee co., situated on both banks of the Kansas river, here spanned by a fine iron bridge, 45 m. S. W. of Leavenworth and 300 m. W. of St. Louis; pop. in 1860, 759; in 1870, 5,790; in 1875, 7,272. The streets are wide and regularly laid out. The city is remarkably well built. The state house is a magnificent building. A site has been

purchased by the United States government for a public building, and a state asylum for the insane is in course of construction about 2 m. W. of the state house. The surrounding country is very fertile and contains deposits of coal. The trade of Topeka is large and rapidly increasing. The Atchison, Topeka, and Santa Fé and the Kansas Pacific railroads afford communication with the east and with Colorado and Texas. The river furnishes good water power. The chief manufacturing establishments are three flouring mills, a rolling mill, a foundery and machine shop, two breweries, a broom factory, and several manufactories of carriages and wagons, and harness and saddlery. There are two national banks, two state banks, two loan and trust companies, and three building and savings associations. The public schools have accommodations for 2,000 pupils, and comprise a high school and seven schools of inferior grades. Other prominent institutions of learning are Washburn college (Congregational), for both sexes; an Episcopal theological seminary; and the colleges of the sisters of Bethany (Episcopal) and sisters of charity (Roman Catholic), for females. The Topeka library association has about 2,000 volumes. Three daily and four weekly newspapers are published. There are 23 religious societies, viz.: 3 Baptist, 1 Christian, 3 Congregational, 1 Episcopal, 1 Jewish, 2 Lutheran (1 Swedish), 4 Methodist (1 German), 3 Presbyterian, 1 Roman Catholic, 1 Spiritualist, 1 Unitarian, 1 United Brethren, and 1 Universalist.—Topeka was laid out in 1854, incorporated as a city in 1857, and made the state capital in 1861.



State Capitol of Kansas.

**TÖPFFER, Rudolphe,** a Swiss novelist, born in Geneva, Feb. 17, 1799, died there, June 8, 1846. He began life as a landscape and genre painter, and subsequently became professor of æsthetics at the academy of Geneva. His works include *Le presbytère* (Geneva, 1839; English translation, "The Parsonage," London, 1848); *La bibliothèque de mon oncle* (1843); *Rose et Gertrude* (1845); *Nouvelles génevoises* (Paris, 1845); and *Collection des histoires en estampes* (6 vols., French and German, Geneva, 1846).

**TOPHET,** a spot in a fertile valley S. E. of ancient Jerusalem, called the valley (*ge*) of Hinnom, or of the children of Hinnom, and hence Gehenna in the New Testament, and watered by the brook Kedron. It was the place where the idolatrous Jews passed their children through the fire to Moloch. At a later period it was used as a spot to throw the garbage of the streets, the carcasses of beasts, and the dead bodies of men to whom burial had been refused; and as a fire was kept constantly burning to consume all that was brought, the word was used metaphorically for hell.

**TOPLADY, Augustus Montague,** an English clergyman, born in Farnham, Surrey, Nov. 4, 1740, died in London, Aug. 11, 1778. He was educated at Westminster school and Trinity college, Dublin, took orders, and obtained the living of Broad Hembury in Devonshire. In 1775 he removed to London and preached in a chapel in Leicester square. For several years he edited the "Gospel Magazine." His fame rests principally upon his controversial writings against the Methodists, and a few hymns. He was the great champion of Calvinism in the church of England. An edition of his works was issued in 1794 (6 vols. 8vo; last ed., with "Life," 1 vol. 8vo, 1869).

**TÖPLITZ.** See TEPLITZ.

**TORENO, José Maria Queypo de Llano Ruiz de Saravia,** count of, a Spanish statesman, born in Oviedo, Nov. 26, 1786, died in Paris, Sept. 16, 1843. In the rising of the Spaniards against the French in 1808 he was sent to England to negotiate for assistance, was afterward repeatedly a cabinet minister, and died in exile. He published *Historia del levantamiento, guerra y revolucion de España* (5 vols., Madrid, 1835–'7; best ed., 4 vols. 8vo, 1848).

**TORFÆUS,** or **Tormodus,** the Latin name of Thormodr Torfason, an Icelandic scholar, born in Engö in 1636, died near Copenhagen in 1719. Frederick III. of Denmark in 1660 made him interpreter of Icelandic manuscripts, of which he made a collection in Iceland. In 1667 he was appointed keeper of the royal collection of antiquities, and in 1682 royal historiographer. Of his works, in which first appeared the northern sagas on the discovery of

America, the most important is *Historia Rerum Norvegicarum* (4 vols. fol., 1711).

**TORGAU**, a town of Prussia, in the province of Saxony, on the left bank of the Elbe, 26 m. S. E. of Wittenberg; pop. in 1871, 10,867. The principal public building is the Hartenfels palace, containing a church consecrated by Luther, whose wife, Katharina von Bora, died here. It has manufactories of linen and woollen goods and a brass foundery. The elector of Saxony and the landgrave of Hesse concluded here a league for the defence of the reformation, March, 1526. In 1576 a conference of Protestant theologians, assembled by the elector Augustus, elaborated here the "Book of Torgau," which formed the basis of the *Concordiæ Formula*. The town was nearly destroyed in the thirty years' war. In the seven years' war Frederick the Great here defeated the Austrians under Daun, Nov. 3, 1760. Napoleon was the original builder (1810) of the present strong fortifications. Torgau was surrendered to the Germans in January, 1814, after a siege of several months, during which more than 25,000 French soldiers died of typhus fever.

**TORLONIA, Alessandro,** prince of Civitella Cesi, Musignano, Canino, and Farnese, marquis of Roma Vecchia and Torrita, an Italian capitalist, born in Rome, June 1, 1800. He is the youngest and most enterprising son of Giovanni Torlonia (born in Siena in 1754, died in Rome, Feb. 25, 1829), who was originally a small shopkeeper, and became a banker of great wealth and influence, and duke of Bracciano. Alessandro increased his patrimony by taking long leases of the salt and tobacco monopolies in the Papal and Neapolitan states, and by other profitable transactions. He became the principal holder of real estate in the city and province of Rome, filled his palace and villa with fine works of art, and rendered many important services to the pope. He has made extensive excavations, and his collection of antiquities is said to rank next to that of the Vatican. The most remarkable of his public enterprises is the draining of Lake Fucino.

**TORNA**, a N. county of Hungary, bordering on the counties of Zips, Abauj, Borsod, and Gömör; area, 239 sq. m.; pop. in 1870, 23,126, chiefly Magyars and Roman Catholics. It is watered by the Bodva, which receives the Torna. The soil is mostly rocky and sterile; the principal products are hemp and wine. About three sevenths of the area is wooded. Capital, Torna.

**TORNADO.** See HURRICANE.

**TORNEA** (Swed. *Torneå*). **I.** A river of Europe, having its source in Lake Tornea-Träsk, in Sweden, and falling into the gulf of Bothnia after a course of about 240 m. It forms part of the boundary between Sweden and Russia. **II.** A town of Finland, Russia, in the län or government of Uleaborg, at the mouth of the Tornea river; lat. 65° 50′ N., lon. 24° 14′ E.; pop. about 700. It has a considerable trade in timber, fish, furs, reindeer skins, tar, &c. Many travellers visit Tornea to see the midnight sun, visible here from the church steeple in the latter part of June. Most of them proceed to Mt. Avasaksa, about 40 m. N., which offers a more advantageous view. Observations for determining the figure of the earth were made at Tornea by Maupertuis in 1736–'7, and by Prof. Svanberg of Upsal in 1801–'3.

**TORONTÁL**, a S. county of Hungary, bordering on the counties of Csongrád, Csanád, Temes, and Bács, and on Slavonia; area, 2,650 sq. m.; pop. in 1870, 413,010, chiefly Magyars and Roumans. It is watered by the Maros, Theiss, Béga, and Temes. The climate is unhealthful, but the soil is very fertile. The chief products are wheat, maize, melons, flax, rice, tobacco, and wine. Many sheep and horses are raised. Capital, Nagy-Becskerek.

**TORONTO**, a city, port of entry, and the capital of Ontario, Canada, county seat of York co., on the N. shore of Lake Ontario, 310 m. S. W. of Montreal and 36 m. N. E. of Hamilton; lat. 43° 39′ N., lon. 79° 21′ W.; pop. in 1861, 44,821; in 1871, 56,092. The bay S. of the city is formed by an island, and is about 3 m. long and 2 m. wide. The river Don, which falls into the bay on the east, is not navigable. The site of the city rises gradually from the water and extends back about 2½ m., connecting on the north with the villages of Yorkville and Seaton, and on the east with Lesslieville, all of which, except in name, form part of the city. The corporation limits include more than 5,000 acres. The Queen's park, in the centre of the N. part of the city, contains over 35 acres; the jail farm is to be converted into a park in the east; and a few miles W. of the present corporation limits, on Humber bay, 300 acres has been secured for a park. The streets intersect at right angles. The buildings in the chief business streets are of brick, white or red, or of cut stone; and whole streets of fine residences of white brick have been built up within a few years, while other streets are occupied chiefly with wooden structures. Among the public buildings are Toronto university and University college building, the finest in the province, erected in 1859 at a cost of about $900,000; the government house, the official residence of the governor of Ontario; the custom house and the post office; the Grand opera house and the Royal opera house, each capable of seating over 1,500 persons; the central prison, which cost nearly $500,000; the city hall and St. Lawrence hall; Trinity college, a church of England institution; Knox's college, a Free church theological institution, just completed at a cost of about $80,000; the college of technology; the normal school buildings; the legislative buildings, in which also are some of the executive departments; Upper Canada college, a preparatory school for University college; and Osgoode hall, the seat of the principal law and equity courts of the province and the headquarters

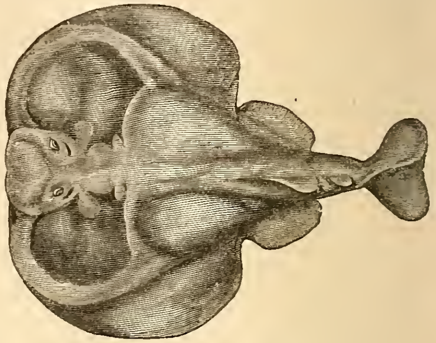
of the benchers of the law society. There are 78 churches, the principal of which are St. James's cathedral, commenced in 1852, and recently completed by the erection of a spire 316 ft. high, at a cost of about $220,000; St. Michael's cathedral, Roman Catholic; the Metropolitan church, Methodist, costing $100,000; St. Andrew's, church of Scotland, $80,000; and the Baptist church. The two principal markets are the St. Lawrence and the St. Andrew's, the latter just completed.—Toronto has railroad communication with the United States and with the principal points of the provinces of Ontario and Quebec by means of the Grand Trunk, the Great Western, the Northern, the Toronto, Grey, and Bruce, and the Toronto and Nipissing lines. The imports for the year ending June 30, 1874, were $14,-716,824, and for the next year $14,436,091. The official returns of exports show in each of these years less than $1,900,000, but they are imperfect. The customs revenue collected in the first of these years was $1,967,997 60, and in the last $1,293,644 34. The value of manufactures according to the census of 1871 was $13,686,093, the chief items being furniture, boots and shoes, rail cars, ale, and whiskey. There are five banks having their headquarters in the city, and branches of five Quebec and Montreal banks. Besides the Toronto savings bank, the assistant receiver general's office, a branch of the Dominion treasury department, receives money on loan at interest; and there are numerous loan societies.—The city is divided into eight wards, each of which annually elects four aldermen, who are vested with legislative and executive powers, and can act as magistrates if possessed of a legal property qualification. The

University of Toronto.

mayor is annually elected by a vote of the rate payers. The assessed value of the real and personal property (not counting stocks in public companies) in 1873 was $44,765,000; in 1874, $43,462,512; in 1875, about $46,000,000. The taxes in 1874 yielded $608,475. The funded debt is about $5,000,000; and at the close of 1874 there was $258,293 to the credit of the sinking fund. The city has a fire alarm telegraph, a paid fire department, and street railways. The water works, which the corporation recently acquired from a private individual, are undergoing improvement and extension, at a cost that will exceed $2,000,000. The water is taken from the lake, and the sand of the island, across which it passes, is made to act as a filtering basin; the filtered water then passes across the bay in sunken pipes, and is pumped up to a reservoir on a height N. of the city. Among the charitable institutions are the asylum for the insane, supported by grants of the provincial legislature, and accommodating about 700 patients; the city hospital, the resources of which, arising from an endowment of public lands, are supplemented by an annual legislative grant; a boys' home and a girls' home, for unprotected children; a newsboys' home; a home for female servants out of employment; a house of industry; a Protestant orphan asylum; and the house of providence, belonging to the Catholics, and mainly supported by them. There are a number of common schools, supported at a cost of about $40,000 a year, besides Roman Catholic separate schools. St. Michael's college (Roman Catholic) has not, like Trinity college, university powers. There are no strictly public libraries, but several semi-public ones, including the legislative library; the library in the normal school, intended for the council of public instruction;

Osgoode Hall library; University college library; the Canadian institute (scientific) library; and the mechanics' institute library. Four newspapers are issued daily, and 17 weekly; and there are 15 literary, scientific, and theological magazines, 11 monthly, 4 bimonthly, and 1 quarterly.—The site of Toronto was selected by Governor Simcoe in 1794 as the seat of the provincial government; and here the capital of Upper Canada remained till 1841, when Upper and Lower Canada (now Ontario and Quebec) formed a legislative union. From 1849 to 1858 Toronto was alternately with Quebec the seat of the united government; and in 1867, when the confederation was formed, it became the permanent capital of the province of Ontario. It was taken by the Americans in 1813, and the legislative buildings and archives were burned. It was known as York till 1834, when it was incorporated as a city.

**TORPEDO,** the generic and popular name of the electric rays or skates of the family *torpedinidæ.* They were called *νάρκη* by the Greeks and *torpedo* by the Latins; the Germans call them *Krampffisch*, the French *torpille*, and the English cramp fish and numb fish. The body is smooth and rounded; the tail short and thick, cylindrical at the end and keeled on the sides; teeth conical, sharp, and crowded; ventral fins immediately behind the pectorals, dorsals generally two and on the tail, and the caudal subtriangular. The electrical apparatus, which has given the name to the family, is arranged in two masses, one on each side of the skull, between this and the base of the pectorals; it is composed of a multitude of perpendicular gelatinous columns or hexagonal prisms, separated by membranous partitions containing a fluid, freely supplied with blood, and receiving very numerous nervous filaments from the par vagum and trifacial nerves. There are about 20 species, arranged in seven genera, in the seas of all parts of the world; the best known are the species of the Mediterranean and the W. coast of Europe, and of the Atlantic coast of North America, all belonging to the genus *torpedo* (Dum.), in which the mouth is crescentic, the teeth not extending outward beyond the margin of the lips, and spiracles distant from the eyes, with a circular fringe around the opening. The common torpedo of the Mediterranean (*T. marmorata*, Rud.; *T. Galvanii*, Bonap.) is sometimes of a uniform brown, but generally marbled or spotted with darker; it rarely attains greater dimensions than 4 by 2½ ft., or a weight of more than 50 lbs. The spotted torpedo of the same sea (*T. ocellata*, Rud.; *T. narke*, Risso) is yellowish red, with one to five large, rounded, grayish blue spots, surrounded by a brownish circle, with a few whitish dots, and grayish white below. One (or both) of these species occurs on the W. coast of Europe as far as Great Britain, and also, it is said, in the Persian gulf and Indian ocean; they feed on small fish, keeping on the mud or sand at the bottom; their flesh is eaten along the Mediterranean. Their electrical apparatus is analogous to the galvanic pile; John Hunter counted 1,200 columns in a very large fish, about 150 plates to the inch.—The American torpedo (*T. occidentalis*, Storer) attains a length of about 4½ ft. and a width of 3 ft.; it is dark brown above with a few black dots, and white beneath; eyes very small, and spiracles directed outward and a little forward. In one specimen Prof. J. Wyman estimated the number of plates at between 250,000 and 300,000, about 1,200 prisms in each battery, each 1 to 2 in. in height, and



American Torpedo (Torpedo occidentalis).

containing about 100 plates to the inch; the interval between the plates was filled with an albuminous fluid, 90 per cent. water, containing common salt in solution; the ganglia from which the par vagum nerves arise are larger than the brain itself, indicating the great nervous power supplied to the battery.—See ELECTRIC FISHES, and *Leçons sur les phénomènes physiques des corps vivants*, by C. Matteucci (Paris, 1847).

**TORPEDO,** a machine for destroying hostile shipping, ponton bridges, &c., through the agency of subaqueous explosions; that is, a military mine used under water. The germ of the device is to be found in floating powder vessels, which were first used at the siege of Antwerp in 1585, and received their latest application in the attempt upon Fort Fisher, N. C., during the late civil war. David Bushnell, a captain of engineers in the American revolutionary army, made the first practical application of the idea to ordinary warfare. He devised a submarine boat to carry a torpedo, charged with 150 lbs. of gunpowder, to be attached by a wood screw to the bottom of an enemy's vessel, and fired by a clockwork fuse. The first actual trial of the invention was made in 1776, when the boat, under the guidance of Sergeant Ezra Lee, was placed under the bottom of the Eagle, an English ship of war carrying the flag of Lord Howe, lying at anchor in New York harbor. But the sergeant found it impracticable to attach the torpedo, which was cut adrift, and soon exploded. In 1777 Capt. Bushnell directed a drifting percussion

torpedo against the frigate Cerberus, lying off New London, and it destroyed a schooner moored alongside. Similar torpedoes were set adrift on the Delaware, but did no harm. (See BUSHNELL, DAVID.) Twenty years later Robert Fulton made vigorous attempts to bring the new weapon into notice, under the name of "torpedo," then first applied by him. Unsuccessful in France, he went to England in 1804, and in 1805 was authorized to make an attempt to destroy the French fleet at Boulogne, which proved unsuccessful. In the same year he blew up the brig Dorothea, assigned to him for experimental trial, in the harbor of Deal. This was accomplished by two drifting torpedoes, which, connected by a rope, fouled the hawser; and one of them, charged with 170 lbs. of powder, exploding by clockwork under her bottom, utterly destroyed her. Notwithstanding this triumph, motives of policy, resulting from their sovereignty of the sea, caused Fulton and his new weapon to be rejected by the English government; and he returned to America to encounter ultimately a like repulse, although in 1807 he repeated his experiment successfully in the harbor of New York. Fulton's system included four classes of torpedoes: buoyant mines, held in place by anchors, and provided with a mechanical device by which explosion ensued when they were struck by a vessel; line torpedoes, of the kind used in the destruction of the Dorothea; harpoon torpedoes, to be attached to the enemy's vessel by a harpoon shot from a gun, and then to be exploded by clockwork; and lastly "blockship" torpedoes, to be carried on spars projecting from a peculiar kind of vessel, and exploded by contact with the enemy. Just before the close of the war of 1812 preparations were made for an extended use of torpedoes in the defence of our harbors. Col. Samuel Colt first practically applied electricity to the ignition of torpedoes. After experimenting for 14 years, and blowing up several vessels at anchor, he finally, on April 13, 1843, destroyed a brig under full sail on the Potomac, operating by electricity from a station in Alexandria, 5 m. distant. He elaborated a complete system of buoyant submarine mines, which were to be planted in groups quincuncially in the channel to be defended. To connect them with the shore he devised one of the very first insulated cables ever attempted, which was connected with a platinum wire fuse imbedded in a priming of gunpowder. He proposed to arrange a reflector to throw the image of the ship upon a map of the mines at the operator's station. This project, bearing the date of 1836, was discovered among Colt's papers after his death. Although much progress was made in submarine blasting, and an elaborate system of electrical submarine mines was prepared by Capt. Hennebert of the French engineers, no opportunity offered for the further use of torpedoes until the Anglo-French war with Russia. In 1855 a new kind of contact mine, devised by Jacobi, was planted off Cronstadt and at Sebastopol; explosions occurred under the frigates Merlin and Firefly, but did no serious damage. The Jacobi fuse consisted of a little bottle of sulphuric acid bedded in a mixture of potassium chlorate and sugar. This bottle being broken by the shock, an explosion ensued, which communicated with the charge and ignited the mine. Had not this engineer employed too small charges of powder (8 or 9 lbs.), his success would probably have been more marked. His system included electrical mines as well as mechanical. The destruction of the docks at Sebastopol was effected by the French engineers through the agency of submarine explosions, and the attention of all nations was thus again called to the subject. The result appeared in the defence of Venice in 1859 by Col. Von Ebner of the Austrian engineers, who originated a system more complete than any which had preceded it. During the civil war in the United States, when the confederates had no fleet, the southern ports and rivers were much exposed to attack, and this method of defence was largely used. The first torpedoes in position were discovered in Mud river, near Fort Pulaski, in February, 1862; they belonged to the simple contact class, and occasioned no damage. In October, 1862, the service was formally legalized by the confederate congress, and a torpedo bureau was soon established at Richmond. A special corps of officers and men was raised and trained for submarine warfare; inventions multiplied, and agents were sent to Europe to provide material and get the latest ideas. The southern waters soon became so dangerous as to interfere seriously with naval operations. The first vessel actually blown up by the new machines was an ironclad, the Cairo, which was totally destroyed on Yazoo river in December, 1862. During the remainder of the war seven United States ironclads, eleven wooden war vessels, and six army transports were destroyed by torpedoes, and many others were temporarily disabled. The confederates lost a fine ironclad, the Albemarle (see PLYMOUTH, N. C.), two steamers in Charleston harbor, and a flag-of-truce boat on James river, in the same manner, the last three accidentally by their own torpedoes. This great destruction chiefly occurred in the last two years of the war. In the Schleswig-Holstein war of 1864, Denmark resorted to ingenious stationary submarine mines, and one of the invading vessels was destroyed. Paraguay employed torpedoes in defending its river coast against Brazil and her allies in 1865–'8. By these the ironclad Rio de Janeiro was destroyed and the Tamandare disabled, although the engineers were crippled by the want of supplies. During the Franco-German war of 1870–'71 the coasts of the Baltic and North seas were effectively protected against the French fleet by torpedoes; and various attempts were made to defend the French rivers in a similar manner.—The recent

changes in naval architecture, which have produced iron-clad vessels capable of enduring for a few moments the heaviest fire of modern artillery, have rendered it necessary to devise means of striking the remaining vulnerable points, viz., the deck and the bottom. The former can be attacked advantageously in many localities only by the vertical fire of mortars; the latter can be most effectively assailed by the torpedo. The chief nations have accordingly established special schools for investigating the subject of submarine warfare, and all possible secrecy is thrown around these studies. In the United States, Great Britain, and other countries a distinction is made between the defensive and offensive branches. The American school for defensive torpedoes is at Willet's Point, New York harbor. The general principles which must govern this service are well established. The most vulnerable points of maritime nations are now their great seaboard cities; hence it is of primary importance to protect the seaports. The invention of the screw propeller and of iron armor has enabled fleets to steam rapidly past the forts, under cover of night or fog, and anchor securely in positions where their fire can either destroy the city or compel the payment of an enormous ransom. The great problem of coast defence is, therefore, to devise an effective obstruction of the channel, which, while allowing the free passage of friendly vessels, shall bar the way to an enemy. This is supplied by defensive torpedoes planted and operated from the forts. If by their aid the enemy can be detained 100 hours under the fire of the forts, when without it he could pass in one hour, the number of the guns is virtually multiplied by 100. For these reasons military engineers are giving the closest possible study to defensive torpedoes, or submarine mines as they are often called. While the details of our system of submarine defences are not made public, its general features have been announced. In a deep casemate of the fort, secure from the fire of the enemy, are placed electrical batteries, operating apparatus, testing galvanometers, &c., under the charge of a thoroughly trained engineer sergeant. A telegraph wire keeps him in constant communication with his officer, who is posted at some commanding point, where the whole channel lies like a map before him. Radiating from the casemate, in subterranean galleries, the torpedo cables extend to the channel, where they terminate in multiple groups of mines so arranged as to be perfectly flanked by the guns of the work. The details of these mines are not public, but an idea of their general construction can probably be formed from fig. 1, which represents the Austrian type. It consists of an anchor, *a;* a buoyant case, *b*, containing the charge, fuse, and circuit-closing apparatus; and the electric cable, *d*, extending to the operating room on shore. These groups are so placed, in successive lines and outlying mines, as to render it impossible for a vessel to pass without moving over some of them. Thickly rising, but never exposed to view, are numerous buoys, each containing a simple electrical apparatus, which instantly report to the sergeant the locality of any vessel touching them. If friendly, the ship passes in safety; but if an enemy, a single motion of the sergeant makes every mine an automatic agent of destruction, ready to deal a tremendous blow at the precise instant when it will be most effective. As the buoys may be slightly in rear of the mines, all attempts to protect the vessel by outrigging frames or nets are futile. Any boat attempting to grapple the torpedoes by night will be overwhelmed by a fire of grape or case shot from the fort, fired automatically by electricity, without the agency of the soldiers sleeping quietly by the guns. The mines are as effective a year after they are planted as when first laid; and if a single cable be injured or a single charge be wet, the fact is automatically reported, and within five minutes after the injury has occurred its existence and nature are known in the fort. A mine can be fired without the aid of the buoys. For secondary channels, the use of which could be sacrificed for a time, less elaborate kinds of torpedoes are provided, not unlike those employed by the confederates in the late war. These mines, once planted, are dangerous alike to friend and foe, as they explode on contact with any vessel. The electric light is employed to aid the forts in arresting operations attempted under cover of the night. Where constant currents exist, as in rivers, use can sometimes be made of double drifting torpedoes, so arranged as to foul with the connecting rope the hawsers of vessels at anchor. On the torpedoes being brought alongside by the force of the current, the same agency, acting on a simple piece of mechanism, soon releases a hammer and causes an explosion.—Offensive torpedoes are employed in the battles of vessels with vessels, and require technical naval skill. They are various in principle, and are receiving the careful study of many naval officers of all nations. The American school for offensive torpedoes is at Newport, R. I. The principal types of this class are the following: spar torpedoes, automatic fish torpedoes, otter or Harvey torpedoes, submarine rockets, and submarine boats. Besides these, there is a mixed class, that of fish torpedoes, which may be directed and controlled through the agency of electricity. These last may be either offensive or defensive. The spar torpedo has given occasion for some of the most brilliant naval

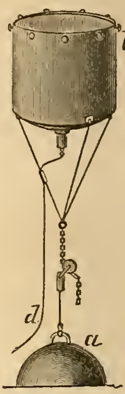


Fig. 1.—Austrian Submarine Mine.

exploits on record, such as that of Lieut. Cushing in the destruction of the Albemarle. Fig. 2 represents the Wood and Lay apparatus used by him. A reserve torpedo, *a*, is shown on its spar *b*. The port torpedo *c* is about to explode. It has been detached from its spar *d* by a pull on a rope, and is rising by its own buoyancy to be fired at the proper moment by the lanyard *e*. Since the civil war boats espe-

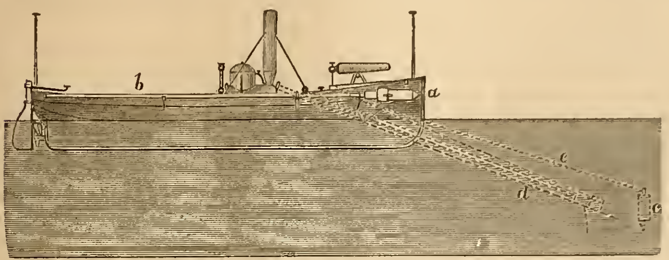



FIG. 2.—Wood and Lay Torpedo.

cially fitted for this kind of attack have been devised by many nations, but the same kind of torpedo may be used from any vessel possessing the requisite speed. The automatic fish torpedo, of which the Luppis Whitehead is most widely known, consists of a small cigar-shaped boat *a*, fig. 3, carrying a contact torpedo in the bow, and containing an engine driven by some powerful agent, like compressed air, which, acting on the propeller *b*, gives it an effective range of about 300 yards. It is started usually from a large vessel, but sometimes from a launch or boat, and passing under water strikes and destroys the object of attack. Usually a directing tube is employed, but for simplicity the engraving shows a device sometimes used in experiments. The otter or Harvey torpedo is emphatically a sailor's wea-

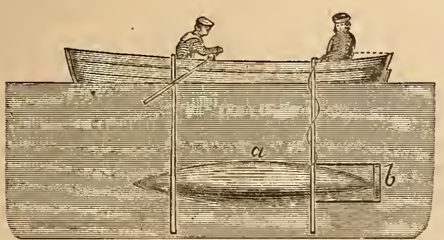



FIG. 3.—Luppis Whitehead Torpedo.

pon, requiring high nautical skill for its use. It consists of a thin vertical copper torpedo case, enclosed in wood, *a a*, fig. 4, and so attached to a tow rope, *b*, leading from a reel on deck through a leading block on the yardarm, as to diverge from the quarter of a fast vessel, whose duty it is to move rapidly past the enemy. The course is so directed as to bring the torpedo in contact and explode its charge under his bottom. This is accomplished by skilfully causing the case to dive at the proper moment, by the slackening of the tow rope, and then, by suddenly checking the latter, making the torpedo rise and explode by contact, either through the agency of a contact fuse acted upon by the levers *c c*, or by electricity. The cork buoys *d d* are used to give the requisite flotation. Official trials in England have shown that when properly handled this is a most effective weapon, and one which admits of use on the high seas as well as in harbors. Submarine rockets, in connection with submarine guns, are now receiving much attention. The design is to render it possible to attack the enemy under his armor by a movable torpedo, in a manner analogous to the ordinary fire of artillery in air. Experiments lead to the belief that this project will ultimately be successful, for the short ranges usual in the combats of armor-plated ships. Submarine torpedo boats

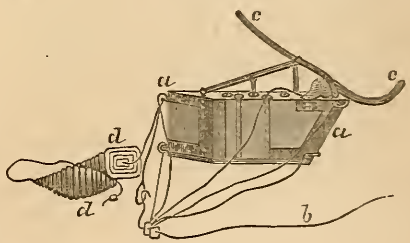



FIG. 4.—Harvey Torpedo.

have been an object of study since the days of Bushnell; and, under the name of Davids, they played a conspicuous part during the civil war, in which the Housatonic was sunk off Charleston by a night attack of this description. The French *plongeur* is a more elaborate type of the same class. The general idea is to form a water-tight vessel, propelled by compressed air, which can be navigated under water to the enemy, there to deliver a blow through the agency of a contact torpedo. As success, and even failure, has heretofore often involved the lives of the crew, the project is not now regarded with much favor. Indeed, it may be said to be superseded by fish torpedoes controlled by electricity, which may be made equally effective without endangering the operators. This device consists essentially of an ordinary fish torpedo, which carries a coil of insulated wire to be paid out as it proceeds. One end of the wire remains with the operator, who can thus at will send a current of electricity, positive or negative, through certain electro-magnets in the fish,

causing a motion of the armatures in either of two directions. This enables him by ingenious devices to control valves which apply the motive power as desired, and thus start, stop, and steer the boat. The idea was first patented by Lieut. Col. Ballard, R. E., but it has been independently elaborated by Mr. Lay, by Mr. H. J. Smith of this country, and by Col. Scheliha in Russia. A modification of the idea has been made by Capt. Ericsson, who places his motive power (compressed air) with the operator, and supplies it to the fish through a flexible tube, thus enabling him to control both its speed and direction. The tube is drawn after the fish as it advances. This kind of torpedo seems to be especially fitted for use on shipboard, where the engines may be made to supply the compressed air, and where, by advancing upon the enemy, a short range can usually be secured.

**TORQUATUS, Titus Manlius Imperiosus,** a hero of Roman story, of the 4th century B. C. He was brought up in privacy in the country, on which account in 362 the tribune M. Pomponius charged his father, who was hated by the people for his haughtiness, with being a tyrannical parent. The young Manlius compelled Pomponius to withdraw his accusation; and this act of filial devotion so pleased the Romans that he was made the same year military tribune. In the Gallic invasion of 361 he slew in single combat a gigantic enemy on the bridge over the Anio upon the Salarian road, and took from his neck the chain (*torques*) and put it around his own; from which circumstance he was called Torquatus. In 353, though he had not yet held the consulship, he was made dictator in order to carry on the war against the Cærites and their allies, and in 349 was again made dictator for the purpose of holding the comitia. He was consul in 347, 344, and 340. In 340 his colleague was P. Decius Mus, and the two were appointed to carry on the war against the Latin league. While they were in the plain of Capua an order was issued forbidding all single encounters with the enemy; but Titus Manlius, the son of Torquatus, fought with Mettius Geminus of Tusculum, and slew him. Returning to the camp, he laid the spoils at his father's feet; but Torquatus assembled the soldiers in the prætorium, and in their presence his son was beheaded. The young men of Rome from that time regarded Torquatus with abhorrence. In this campaign a great victory was gained over the Latins at the foot of Mt. Vesuvius, and Torquatus returned to Rome in triumph. According to the *Fasti*, he was dictator again in 320, but the dates of his life vary in different authors.

**TORQUAY,** a town of England, in Devonshire, on a peninsula on the N. E. side of Tor bay, 167 m. W. S. W. of London; pop. in 1871, 21,657. It has two principal streets lined with substantial houses of limestone, with several fine churches, a town hall, theatre, numerous schools, assembly and reading rooms, a mechanics' institute, and a public garden. Earthenware, yellow ochre, cider, and fish are exported. It has grown up within 50 years from a fishing village, and owes its progress mainly to its fine climate, making it a desirable health resort. Tor bay is a large and well protected harbor. William of Orange landed here in 1688. In the vicinity are the ruins of Torquay abbey, founded in 1196. About a mile from the town is Kent's hole, or cavern, in which have been found bones of the elephant, rhinoceros, bear, hyæna, and other animals now extinct in England. It has been penetrated to the depth of 600 ft., and scientific explorations are still in progress.

**TORQUEMADA** (Lat. Turrecremata), **Juan de,** a Spanish theologian, born at Valladolid in 1388, died in Rome, Sept. 26, 1468. He became a Dominican friar in 1403, accompanied his superior to the council of Constance in 1417, graduated in the university of Paris in 1424, taught theology there, and was successively chosen prior of the Dominican convents of Valladolid and Toledo. In 1431 he was appointed by Pope Eugenius IV. "master of the sacred palace," and his own theologian at the council of Basel. He there contributed to the solemn condemnation of the doctrines of Wycliffe and Huss, and maintained that the doctrine of the immaculate conception was divinely revealed. In 1439 he attended the council of Florence as papal commissary, and was foremost in drawing up the "articles of reunion" between the Greek and Latin churches, receiving on this occasion from the pope the title of "defender of the faith." He was made a cardinal on Dec. 18 of that year. In 1440 he attended in the pope's name at the national council of Bourges, where he succeeded in keeping the French prelates on the side of Eugenius IV. He became bishop of Palestrina in 1455, and of Sabina in 1464. His most important works are: *Meditationes Joannis de Turrecremata positæ et depictæ de ipsius mandato in Ecclesiæ Ambitu Sanctæ Mariæ de Minerva* (fol., Rome, 1467, with 34 engravings on wood); *Expositio brevis et utilis super toto Psalterio* (4to, Rome, 1470; fol., Augsburg, 1472, with many subsequent editions); *Quæstiones Spiritualis Convivii delicias præferentes super Evangeliis* (fol., Rome, 1477; Nuremberg, 1478); *Commentarii in Decretum Gratiani* (6 vols. fol., Lyons, 1519; Venice, 1578; 2 vols., Rome, 1726). Many of his works have not been published.

**TORQUEMADA, Tomas de,** the first Spanish inquisitor general, born at Torquemada about 1420, died in Ávila, Sept. 16, 1498. He became a Dominican and prior of the monastery of the Holy Cross in Segovia, and in 1483 was made inquisitor general for Spain by Ferdinand and Isabella, in which post he was confirmed by the pope on Oct. 17. From him the inquisition received its thorough organization. Tribunals were established at Seville, Cordova, Jaen, and Ciudad Real (later transferred to

Toledo), and a code was promulgated by which the Spanish inquisition was afterward governed. Jews and Moors were expelled under his control, and he so multiplied *autos de fe* that Alexander VI. intervened and gave him four colleagues to moderate his zeal.

**TORRES VEDRAS**, a town of Portugal, 25 m. N. N. W. of Lisbon, on the left bank of the Sizandro; pop. about 4,200. Part of its ancient walls and an old fortress still remain. In the vicinity are an aqueduct with Gothic arches and the noted convent of Varratojo. It has four churches, two hospitals, a Latin school, and a considerable trade in wine. It gave its name to the defensive lines erected by Wellington in 1810 on a range of heights in its neighborhood, which took nearly a year for their completion, and set the army of Masséna at defiance.

**TORREY, John**, an American botanist and chemist, born in New York, Aug. 15, 1796, died there, March 10, 1873. He graduated at the New York college of physicians and surgeons in 1818. While a student there he was one of the founders of the New York lyceum of natural history, of which he was for many years president. In 1824 he became professor of chemistry, mineralogy, and geology at West Point, and in 1827 was called to the chair of chemistry in the college of physicians and surgeons, which he held till 1854. He was also at the same time professor of chemistry in the college of New Jersey; and in 1836 he was appointed botanist of the geological survey of the state of New York. In 1854 he became United States assayer at New York, which office he held until his decease. Though better known as a botanist, he was a profound chemist, and was the frequent confidential adviser of the government, especially in matters relating to coinage and currency. Dr. Torrey's first publication was "Catalogue of Plants growing spontaneously within Thirty Miles of the City of New York" (Albany, 1819). In 1824 he published the first volume of the "Flora of the Northern and Middle States." This was not continued, but in 1826 he gave in a "Compendium," in a condensed form, the materials he had accumulated. In 1838 he began the publication, in connection with Prof. Asa Gray, of the "Flora of North America," which appeared at intervals till 1843, when it was discontinued on account of the vast amount of new material brought to light by exploration. From 1822 to 1858 he prepared the botanical reports, some of them in connection with Dr. Gray, of most of the United States exploring expeditions. Among his other publications are "Cyperaceæ of North America" (1836), and "Flora of the State of New York," in the series of reports of the natural history survey of the state (2 vols. 4to, 1843-'4). He was also the author of numerous botanical, chemical, and mineralogical papers in the "Smithsonian Contributions" and other scientific publications. His herbarium, the result of 40 years' collection, and his botanical library, one of the most valuable in the country, were transferred to Columbia college some years before his death.

**TORREYA**, a genus of evergreen coniferous trees, named by Arnott in honor of Dr. John Torrey, from specimens collected in Florida by the late Mr. Croom. It belongs to the yew tribe of conifers, in which the fruit does not form a proper cone, but becomes a sort of fleshy fruit or drupe. The Florida species, *T. taxifolia*, is confined to a rather limited locality near Aspalaga, on the Appalachicola river, in middle Florida; it is 20 to 40 ft. high, with a trunk 6 to 18 in. through, and has much the general aspect of the common hemlock spruce (*abies Canadensis*). There was formerly a considerable forest of Torreyas, but all the trees not growing in inaccessible ravines have been used for lumber and steamboat fuel. The leaves, mostly in two rows, are about 1½ in. long, thick, rigid, sharp-pointed, and rather light green; the flowers are diœcious, the fertile ones bearing a drupe about the size and shape of a small olive,

Torreya taxifolia. Leaves half the natural size; staminate and pistillate aments enlarged; fruit and a section reduced.

consisting of a hard nut surrounded by a thin pulp. The wood, which is very durable, gives off when sawed or burned a strong terebinthinate and somewhat unpleasant odor, on which account it was called in Florida "stinking cedar." The tree has proved hardy in the latitude of New York.—Not long after the discovery of the original species, Siebold and Zuccarini described *T. nucifera*, discovered in northern Japan, but cultivated in all parts of that country, where the oil obtained from its seeds is used for culinary purposes. Another species, discovered by Fortune in the mountains of northern China, and described as *T. grandis*, is a large fine tree, possibly not belonging to this genus. Among the wonderful stories told about California in the early days of its present era was the discovery of the nutmeg tree growing wild in the mountains, and the tree was mentioned as *myristica Californi-*

*ca;* materials were sent to Dr. Torrey, who found it to be a new species of the genus bearing his name, and he described it as *T. Californica.* It grows from 40 to 50 ft. high, and has a smooth bark, and leaves from 2 to 2½ in. long; the nut bears much similarity in size and shape to the nutmeg, and the ruminated albumen shown when it is cut adds to a resemblance that is not borne out by the taste, which is that of turpentine. Another species is mentioned as having been found in the Bogotá Andes, though little is known about it. The Torreyas flourish well in England, but trees of other than the Florida species have not been sufficiently tested to know how they will succeed in our Atlantic states.

**TORRICELLI, Evangelista,** an Italian mathematician, born in Faenza, Oct. 15, 1608, died in Florence, Oct. 25, 1647. He received a mathematical education in a Jesuit school at Faenza, which he completed at Rome. Some tracts written by him upon the dialogues of Galileo excited the latter's attention, and he invited Torricelli to Florence, who soon became his successor in the academy as professor of mathematics. His greatest discovery is that of the barometer. (See Barometer.) He published *Opera Geometrica* (4to, Florence, 1644).

**TORSION BALANCE.** See Balance.

**TORSK, or Tusk.** See Cusk.

**TORSTENSON, Lennart,** count of Ortala, a Swedish general in the thirty years' war, born at Torstena, Aug. 17, 1603, died in Stockholm in April, 1651. In 1618 he became a page at the court of Gustavus Adolphus, and as captain of the king's body guard accompanied him to Germany in 1630, where he directed the artillery. In 1632 he contributed materially to the passage of the Lech, but was captured during the assault on Wallenstein's headquarters near Nuremberg. He was carried to Ingolstadt, and the severity of his imprisonment made him an invalid for life. On his exchange and release he was placed at the head of an army corps, and in 1633 he invaded Bavaria and captured Landsberg. In 1635 he operated against the Poles in Prussia, and subsequently marched to the relief of Baner, and was with him in the campaign of 1636–'7. In 1641 he was made field marshal and succeeded Baner as generalissimo of the Swedish armies in Germany. With a reënforcement of 8,000 men he joined the confederates in the duchy of Lüneburg, marched through the territories of Brandenburg into Silesia, stormed Glogau, and in May, 1642, gained a great victory at Schweidnitz over Franz Albrecht of Saxe-Lauenburg. He then pushed into Moravia and reduced several cities, but retreated to Saxony before superior forces, and laid siege to Leipsic. Here he was attacked on Oct. 23 (N. S., Nov. 2) by the archduke Leopold, on the plain of Breitenfeld, and the conflict resulted in the signal defeat of the imperialists. Torstenson, again resuming the offensive, reduced all Saxony, invaded Moravia, and laid the country under contribution as far as the Danube. In the mean time Denmark had entered into a secret alliance with the emperor; and Torstenson, marching with wonderful celerity from Moravia into Holstein, late in 1643, soon conquered the Danish peninsula, with the exception of Glückstadt and Krempe. After an abortive attempt on the part of Gallas to check his return to Germany, Torstenson advanced into Bohemia, and on Feb. 24, 1645, gained the battle of Jankau, which secured the submission of Moravia; and, obtaining the control of the Danube, he took even the fortifications which covered the head of the bridge at Vienna. Deserted here by his allies, he retreated into Bohemia, and in 1646 his infirmities obliged him to give up the command to Wrangel. In 1647 he was made a count.

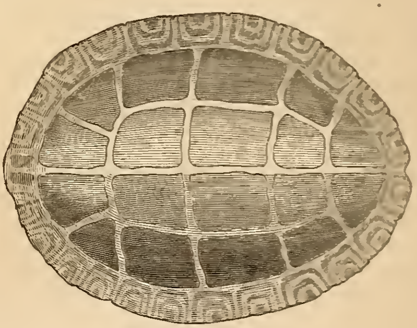
**TORT** (Lat. *tortus*, from *torquere*, to twist), in law, a private or civil wrong or injury, in contradistinction from a crime against the public or the state, but not technically including breaches of contract or other agreements. Torts are injuries or infringements of the civil rights that belong to individuals considered merely as individuals, while crimes are wrongs which affect the community and so invade and violate the rights of society. The distinction between private injuries and public wrongs seems to be much dependent on the constitution and positive laws of civil society. So long as the harm done by an offence is limited to the single individual against whom it was directed, the offender commits only a private injury or a tort; but if the act, though immediately concerning an individual, disturbs the public order or safety and welfare, then the positive law interposes and elevates the hitherto private offence to the degree of a crime or of a misdemeanor. In some cases the injury may be both public and private, or at once a tort and a crime or misdemeanor. For example, the commission of a battery subjects the aggressor to a public prosecution as a disturber of the peace, while the party beaten may have his separate civil action for damages. Libel and nuisance are other examples of this twofold character.—As wrongs are privations or infringements of rights, so torts, being private wrongs, are infringements of private rights, or the rights of individuals. These rights respect either the person or the property. In the former class is included the right of personal security, in respect as well to the body as to the health and the reputation, and the violations of this right in one or other of these respects bear the names battery, assault, nuisance, slander, libel, and malicious prosecution. In this class is included also the right of personal liberty, which is violated by false imprisonment. Rights of property, real or personal, may be infringed by trespasses in various degrees by waste, conversion, and fraud, and the more incorporeal of these rights by nuisance and by infringement of patents and copyrights and rights in trade marks. These several names of torts have been applied by

long usage of the law to prescribed and well determined offences. But besides these there are many torts not specifically designated or classed, because they do not affect well defined classes of rights, but vary with the peculiar circumstances of every case.—When one alleges that a tort has been committed against him, he must show at all events that he has been wronged. The mere fact that the act complained of has injured the plaintiff, does not entitle him to claim indemnity unless the act was also a breach of a legal obligation between the parties, resting either on their express agreement, or on the general policy and rules of the law. If, for example, my neighbor builds a wall just before windows of mine, to which it is conceded I have no prescriptive right as ancient lights; or if in a street occupied by private and costly dwellings my neighbor chooses to use his house for a shop, or convert it to other uses offensive to me and yet constituting no nuisance: in neither case have I ground for action, however considerable the actual injury or damage may be to me. The reason is, that I have not been wronged; it is a case of what the law calls *damnum absque injuria*, damage but no wrong; no legal right of mine has been violated. But every legal wrong imports damage in the very nature of it; and if no other damage is established, the party is entitled to nominal damage. To use Sir John Holt's quaint and familiar illustration: "If a man give another a cuff on the ear, though it cost him nothing, nay, not so much as a little *diachylon*, yet he shall have his action." It is on this principle that, without proving any actual damage, one who has a right of way may maintain an action against an intruder, or one whose lands are flowed against him who constructs a dam so as to set back the water. So a voter can sustain suit against the authorities for refusing his ballot, even though his candidate was elected. These are cases of legal wrongs, infringement of legal rights; and even if no actual damage be proved, the injury or damage is the presumption of the law. To this class also belong those cases of torts in which the legal wrong consists in the doing of a mischievous act which is only likely to prove injurious to others, or even in the doing of a legal act in such a careless or negligent manner that injury may probably result; for carelessness of the rights of others is in itself morally wrong, and by the construction of law is legally wrong when injury results from it.—The commonest form of a tortious intrusion upon real property is called trespass *quare clausum fregit*, or for breaking and entering upon the plaintiff's close. A higher offence against a person, in respect to his property, than mere encroachment on his possession, is that which consists in a usurpation of the property itself. An injury of this nature is most likely to happen in respect to personal property, and one of the most frequent actions for torts of this nature is that of trover. One may be further injured in his rights of property by the effect of threats, mistake, or fraud. In the last respect, for example, an action lies when one knowingly utters a falsehood to the plaintiff with the design to deprive him of a benefit and to acquire it to himself, and damage naturally results from the plaintiff's belief. But it is not always necessary to show that the defendant intended to defraud the plaintiff particularly. Thus one who makes a false recommendation of another, representing him to be solvent and trustworthy, and with the purpose of obtaining credit for him, is liable to any one who gives credit to the report and thereby suffers injury. The tort of nuisance consists in injury to the more natural rights of individuals, and the tort of infringement of patent and copyrights and rights to trade marks violates rights created and assured by the positive law.—In our examination of torts we have thus far considered persons only in their natural capacity. It is obvious that new rights arise and new wrongs become possible when the individual is clothed with an artificial character; when, for example, he becomes a sheriff, a magistrate, or other public officer. The new functions with which he is invested give him capacity for doing official wrongs; and these, as they affect private individuals, form new classes of torts.—A corporation is liable like an individual for its torts, and it is liable for the wrongful acts of its officers, either where they are expressly authorized to do the acts, or where they were done *bona fide* in pursuance of a general authority. But, generally speaking, it cannot be held for any offences by its servants that are properly, in any case, only personal acts, like malicious prosecution, slander, or false imprisonment. But a corporation has been held responsible for an assault and battery committed by a servant acting under its authority. Municipal corporations are liable in tort for the same acts that would warrant an action against individuals, if such acts are done by the authority of the corporation or of a branch or bureau of its government, authorized to act in the premises to which the particular act relates. Thus they must answer for nuisances on their lands, and they are generally held liable for injuries resulting from the want of care or skill on the part of a public surveyor, from the careless performance of street grading, from neglect to repair streets, sewers, and drains, or from the fury of a mob. The civil liability of municipal corporations for injuries sustained by defects in the highway is generally determined by express statutes.—For the various kinds of torts, and of actions for tort, see Assault, Attachment, Copyright, Execution, Libel, Master and Servant, Nuisance, Patents, Sheriff, Slander, Trade Mark, Trespass, and Trover.

**TORTOISE**, the popular name of the chelonian reptiles whose habits are wholly or in part terrestrial and fluviatile, including all the

testudinata except the marine species or turtles —that is, the *amydæ* of Oppel as distinguished from his *chelonii*. Their general characters have been given under TESTUDINATA. The suborder *amydæ*, according to Prof. Agassiz, comprises the following seven families, not equally related to each other: *trionychidæ* or soft tortoises, *chelyoidæ* (the matamata), *hydraspididæ*, *chelydroidæ* or snappers, *cinosternoidæ* or mud tortoises, *emydoidæ* or terrapins, and *testudinina* or land tortoises. Of the very numerous species here included, space will permit the mention of only a few of the typical forms in the above order of families. Duméril and Bibron divide the *amydæ*, according to habitat, into *chersites* or land tortoises, corresponding to *testudinina*, and *élodites* or marsh tortoises, including all the other families except the *trionychidæ*, which form their *potamites* or river tortoises. Though some pass nearly all their life in the water, none are entirely aquatic, and none can swim unsupported for great distances; when in the water, they usually remain at the bottom, and seldom swim freely except when alarmed or seeking to leave it. Their locomotion is a kind of walking, the weight being about equally distributed on the front and hind limbs, which have nearly the same development, the motions of each pair alternating with each other. The shield or carapace is more symmetrical than in the turtles; the feet are always distinct from the legs, and movable upon them; the toes are either separate and short, or united by a web capable of expansion and contraction; the limbs can generally be withdrawn under the carapace, and the head wholly or partially. The tortoises rank higher in the order than the turtles.—In the *trionychidæ* the carapace is flat, thin, and oval, and very incomplete, the ribs united only on the median line, and extending thence to the margin like spokes of a wheel; it is covered with a tough skin, flexible on the margins; neck long and flexible; head pointed, and terminating in a long leathery snout; jaws covered with a horny sheath, and the lips fleshy; feet short, broad, and strong, five-toed and fully webbed, three of the toes with claws; limbs only partially retractile and moving horizontally; skin loose and free about the neck and limbs. The oldest geological deposit in which any of this family has been discovered is the greensand of New Jersey. They are active species, preferring the muddy bottom of shallow water, sometimes lying concealed in the mud with only a part of the head exposed, taking breath from time to time by stretching up their long neck and raising the tip of the snout above the surface; they can remain under water more than half an hour at a time, rarely going on land, where their movements are awkward; in the water they move rapidly, striking suddenly at objects by means of their long neck; they prey principally on fish, seizing also frogs, small birds, and young alligators and lizards; the species found in the Nile is very destructive to young crocodiles; they have been known to attack persons bathing. They are very wary, but are frequently caught on hooks baited with a live fish; their flesh is highly esteemed. Their eggs are numerous, spherical, and very brittle; they are deposited on sandy shores near the water in April and May, and the young appear in July. The genus *trionyx* (Wagler), equivalent to *cryptopus* (Dum. and Bibr.), is peculiar to Asia and Africa, the species of this country formerly referred to it belonging to the genera *aspidonectes* (Wagler), *platypeltis* (Fitz.), and *amyda* (Ag.). The common soft-shelled tortoise of the northern states (*A. spinifer*, Ag.) attains a length of 14 in.; it is yellowish brown, beneath white, mottled, streaked, and dotted with black; a blunt keel along the median line slopes uniformly to the sides, and the anterior margin is furnished with spines; it is found from Lake Champlain to Pennsylvania and west to the Missouri and Mississippi rivers; its flesh is very delicate. Other species are found in the southwestern states. Very large species of this family were brought here from western equatorial Africa by Mr. Du Chaillu.—The *chelyoidæ* somewhat resemble the preceding family, but the head and neck are more retractile and furnished with numerous membranous fringes and lobes of singular form. There is only the single genus *chelys* (Dum.), and a single species, the matamata (*C. matamata*, Dum.), attaining a length of 2 or 3 ft.; it inhabits the stagnant waters of tropical South America, feeding on fish; it is captured for its excellent flesh.—The *hydraspididæ*, containing the genera *platemys*, *podocnemys*, &c., were united to the chelyoids by J. E. Gray, the two forming the *élodites pleurodères* of Duméril and Bibron. The neck is long, the head retractile or bent laterally under the shield; in some the skull presents the union of the temporal and parietal bones to form a broad roof over the temporal region, as in marine turtles, combining thus the family characters of the two suborders. Prof. Agassiz thinks that *podocnemys* will be found to agree more closely with the earlier geological types than with any other, and that the group of *pleurodères* bears the same relation to other testudinates that the marsupials do to ordinary mammals. The sexual differences are so great that they have been mistaken for specific; the tail of the male is much the longer, and in this sex there are sharp asperities between the joints of the hind legs; the colors are also different. This group is foreign to the United States, and mostly South American, a few being found in Africa and Madagascar.—The *chelydroidæ*, described in the article SNAPPING TURTLE, are thoroughly aquatic, and the lowest of the *amydæ* except the preceding families; they are characterized by their keeled back, serrated margin, broad, flat, and imperfectly retractile head, narrow and cross-like sternum, and large tail.—The *cinosternoidæ* have a long

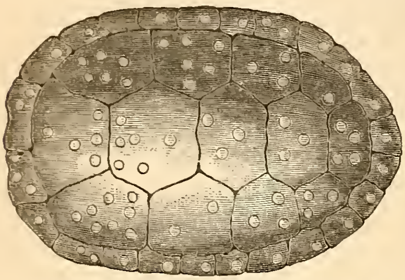
and narrow body, the carapace rising to behind the middle, and thence descending steeply backward; the whole shield is ossified, covered with large horny scales, and as wide behind as in front, with a tendency of the edges to round up and turn inward; the tail is neither long nor strong enough to bear any of the weight of the body, and in the male ends in a horny nail; legs slender, feet short and round, toes freely movable and webbed, and the whole very flexible; head long behind and short in front of the eyes, pointed, with the small mouth underneath; alveolar ridge sharp, the lower jaw ending in a point; neck long and slender; the plastron is sometimes hinged. In average size they are the smallest of the order, the least being about 4 in. and the largest 9 in. in length; all are American, and no trace of their fossil existence has been discovered; the sexes are very different. They live mostly in water and in the mud, coming out to bask in the sun in places where they can readily drop into the water at the approach of danger; their food is principally animal, and their motions quick, though feeble and awkward; generally timid, they bite fiercely if attacked while feeding, like the insectivora among mammals. The colors are generally dark, sometimes with reddish, greenish, and yellowish tints. They lay three to five eggs, on the shore near the water, in holes dug with their hind feet; they are elongated, with a smooth and shining surface, thick, and brittle. In the common mud tortoise (*thyrosternum Pennsylvanicum*, Ag.), the jaws are strong and cutting, and the mouth long and narrow; it is dusky brown above, yellowish dusky or brownish below; chin and throat dirty yellow, with the warts on the latter brighter; it is usually about 3½ in. long, nearly 3 in. wide, and 1¾ in. high. It is found from Pennsylvania to Florida, and west to the Mississippi valley; the anterior and posterior parts of the sternum are movable on the central piece; it abounds in muddy ponds, feeding on small fish and aquatic insects and larvæ; it is a pest to anglers, seizing the bait set for better game; it has a slight odor of musk, but less so than the musk tortoise (*ozotheca odorata*, Ag.), which ranges from New England to Florida, and west to the Mississippi.—The *emydoidæ* are most numerous in species, over 60 being described, presenting great differences in size, structure, and habits. The body is ovate, swelling in the centre, the margin with a tendency to spread outward; the carapace is completely ossified and united by sutures, high and irregularly convex in all directions; plastron long and broad, and sometimes hinged; the jaws horny, without lips, and not terminating in long sharp points; head, neck, and limbs completely retractile; nostrils at the end of the snout, which is not prolonged into a proboscis; toes long and webbed, or short and free, according as the habits are aquatic or terrestrial; skin of head, neck, limbs, and tail more or less scaly. They are principally aquatic, though some are terrestrial, the limbs moving horizontally while swimming, and walking being performed on the whole foot (as in plantigrades); they are generally of moderate size, the smallest being 4 in. and the largest (the aquatic) 15 in. in length. The food is both animal and vegetable, consisting of fish, worms, larvæ, berries, leaves, and grass; they are most abundant in warm regions. The eggs are laid in holes dug by their hind legs, the terrestrial species laying 2 to 7, and the aquatic 10 to more than 30; the shell is less calcareous and more flexible than is usual; the shape is oblong. Though this family is most numerous in North America, there is not a single species described under the genus *emys* by herpetologists which belongs in it; the so-called *cistudo Blandingii*, corresponding to the *emys* of Europe, is the only representative here of Brongniart's genus; the others belong to various genera as established by Agassiz in vol. i. of his "Contributions to the Natural History of the United States" (1857). The genera *trachemys* (Ag.), *ptychemys* (Ag.), *deirochelys* (Ag.), and *malacoclemmys* (Gray) have been described under Terrapin. The



Shell of the Painted Tortoise (Chrysemys picta).

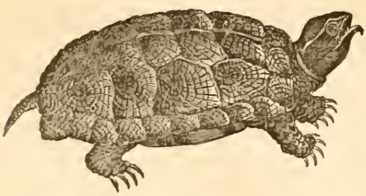
common painted tortoise (*chrysemys picta*, Gray) may be known by the yellow borders of the black dorsal scales, the blood-red blotches and lines on the marginal plates, limbs, and under part of tail, and the golden yellow sternum. It is found as far north as New Brunswick, through the eastern and middle states to South Carolina and Georgia; west of the Ohio it is replaced by the *C. marginata* (Ag.); it is about 6 in. long, 4½ in. wide, and 2¼ in. high; it is most abundant in ditches and sluggish waters, spending most of the day basking in the sun; it is very timid, hibernates early, and is one of the first to appear in spring; it feeds on insects, worms, tadpoles, &c., and is very troublesome to anglers; it will survive only a few days out of the water. The speckled or spotted tortoise (*nanemys guttata*, Ag.) is another very common species, distinguished by its yellow dots on a black ground, and its blackish sternum bordered with yellow. It is found from New England to the Carolinas,

east of the Alleghanies; it often comes on land, to feed on worms and orthopterous insects; it is about 5 in. long, 3 in. wide, and $1\frac{3}{4}$ in. high. The geographic tortoise (*graptemys geographica*, Ag.) is so called from the network of reddish brown lines spread irregularly over the dark brown carapace, somewhat resembling the outlines of countries on a map. It is one of the most active and bold of the family,



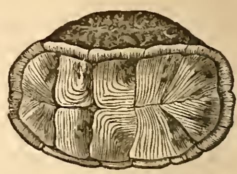
Shell of Speckled Tortoise (Nanemys guttata).

and is found from New York and Pennsylvania to Michigan, Tennessee, and Arkansas; it is over 8 in. long, 6 in wide, and 3 in. high, with a tail of $2\frac{1}{2}$ in. The sculptured tortoise (*glyptemys insculpta*, Ag.) is very common in the northern states as far south as New Jersey; the carapace is reddish brown, each scale with radiating yellow ridges, often smoothed down in old specimens; marginal plates and sternum yellow, each with a black spot at the posterior angle, and generally with concentric striæ; limbs brick-dust color below; it is 8 in. long, 5 in. broad, and about 3 in. high, with a tail of over 2 in.; it passes long periods away from water. Blanding's tortoise (*emys meleagris*, Ag.) is the only true species of the genus here; it is black above with numerous yellow spots, sometimes arranged in lines; below dusky yellow, each plate with a large quadrangular dark spot at the outer and posterior angle. It is found from New England westward to Wisconsin, being most abundant on



Sculptured Tortoise (Glyptemys insculpta).

the prairies, and very terrestrial in its habits; it is 8 in. long, $5\frac{1}{2}$ in. wide, and 3 in. high, with a tail of $2\frac{3}{4}$ in. The box or checkered tortoise (*cistudo Virginea*, Ag.; *C. clausa* and *Carolina* of other authors) has a rough and strong shell, generally of a light brownish color with very numerous bright yellow blotches and lines, more or less radiating, giving somewhat the appearance of tortoise shell; sternum usually yellowish with dark blotches; hind feet plantigrade; plastron with a hinge in the middle, so that the anterior and posterior portion can each be brought in contact with the carapace, and enclose the animal in a perfect box. It is about $6\frac{1}{2}$ in. long, $4\frac{1}{2}$ in. wide, and $2\frac{3}{4}$ in. high; it is found from New England south to the Carolinas, and west



Shell of Box Tortoise (Cistudo Virginea).

to Michigan; it is entirely terrestrial, and a very poor swimmer; it is common in the pine barrens of the southern states, where it is called cooter and pine terrapin by the negroes; it feeds on insects and succulent plants, and is easily domesticated.—In the *testudinina* or land tortoises the carapace is entirely ossified, very convex in the middle region, but well balanced; the plastron is broad, flat, and solid; openings for protrusion of limbs small and narrow; head, limbs, and tail completely retractile within the shell, and the plastron in some with movable lobes; head small and shielded, nose broad, and eyes far apart; alveolar margin with a sharp edge, and the jaws fitting closely by ridges and furrows; skin everywhere more or less scaly; toes mostly concealed under the skin, as far as the last joints, which are free and covered by flat sharp nails, usually five anterior and four posterior; feet short, stout, and somewhat clubbed; the great intestine is longer and the lungs are larger than in any other testudinate, in relation with the greater convexity of the shell. They are most abundant in warm climates, and are the largest of the order, the great Galápagos tortoise being 3 to 4 ft. long, the African coui (*psammobates radiatus*, Fitz.) $1\frac{1}{2}$ ft., the gopher 1 ft., and the common European land tortoise 8 in. (the smallest of the family). Here also belongs the fossil gigantic *colossochelys Atlas* (Cautl. and Falc.), from the Sivalik hills, which must have measured nearly 18 ft. in length; it is found with the great extinct ungulates which it so much resembled in gait and habits. There are no tortoises indigenous to the British islands, though they might easily be naturalized there. Agassiz places all the American *testudinina* in the genus *xerobates*. They live entirely on land, and when put into water walk on the bottom; the body is raised on the last joint of the toes, and the gait is firmer, more steady, and less slow than in any other tortoise. Their food consists of succulent plants and fleshy fruits. There are only eight genera, but many species. The gopher tortoise (*testudo polyphemus*, Daudin) is about 15 in. long, and has a nearly flat shell, the plates marked with concentric striæ disappearing in old age; the plastron is thick and firm, projecting beyond the carapace in front, and deeply emarginate behind; the head is short,

thick, and obtuse, covered with plates; the eyes are large, with a dark iris; the jaws covered with horny, serrated plates; the neck short, and its skin granulated; the fore limbs very large and thick, compressed antero-posteriorly, with five fingers armed with strong nails; along the outer edge of the forearm is a row of projecting horny points; the hind limbs are short, thick, rounded, with four toes armed with strong nails. The general color is brownish yellow, with darker brown tints, the head almost black, the lower parts dirty yellow, and the limbs dusky. It is found in Florida, Alabama, and Georgia, but does not appear to go north of the Savannah river. Like the rodent gophers, they burrow in the ground, preferring such dry and sandy places as the pine barrens, where they exist in troops; they live entirely on vegetable food; they are fond of basking in the sun, though they cannot bear its full summer heat, and cannot endure rain; they become torpid in winter. The adults are very strong, moving with a weight of 200 lbs., and the females are the largest; the flesh and the eggs are esteemed as food. In the European land tortoise (*testudo Græca*, Linn.) the carapace is oval, somewhat widest and gibbous behind, marbled with black and yellow; plastron pale yellow with a wide blackish band down each side; legs short, and tail ending in a horny tip. It is found in Spain, Italy, Greece, and other countries bordering on the Mediterranean; in England it has been domesticated and known to live more than a century. The Galápagos tortoise (*megalochelys Indica*, Fitz.; *testudo elephantopus*, Harlan) is the largest of the order, frequently measuring 12 ft. in circumference; the shell is very convex and of a deep brown color. It is very fond of water, drinking large quantities, and delighting to wallow in the mud like a pachyderm; some live in the mountains and others in the low lands of the Galápagos islands, and the latter in their journeys after water in the elevated regions have worn well beaten paths, which led mariners to the discovery of the springs, often at a great distance from the shore; they drink by immersing the head up to the eyes, and swallowing great mouthfuls, about 10 a minute, according to Darwin; their flesh is excellent and largely used both fresh and salted, and a very clear oil is made from the fat. They feed on succulent plants and vegetables, and in captivity are fond of cabbage, lettuce, and marrows. They were formerly very numerous in these islands, and probably live for centuries. Their gait is very slow, about two miles in 24 hours, though they have been known to travel four miles in the same time. The eggs are laid in October in the sand, and are about 8 in. in circumference; the young are devoured by birds of prey; in Great Britain, where numbers have been kept alive, they go under ground in November and reappear in the middle of April; many have been seen in the United States.—The tortoise shell of commerce is the product of the hawk's bill or imbricated turtle. (See Turtle.)

**TORTOISE PLANT**, a plant of the yam family, from the Cape of Good Hope, also called elephant's foot, these two common names being equivalent to its systematic name, *testudinaria elephantipes*. While its habit is strikingly unlike that of the yam (*dioscorea*), it is so close to that in flower and fruit that a description of one will answer for both. (See Yam.) The yam makes an underground, thin-skinned, tuberous root, or rootstock; but in this the same portion is above ground, and very large, while the stem proper is slender; several stems from the same rootstock climb to the height of 20 to 40 ft., throwing off numerous branches, which bear bright green heart-shaped or kidney-shaped leaves. It is often cultivated as a greenhouse climber for its pleasing foliage, and for its curious rootstock; this is hemispherical or nearly globular, and sometimes 3 ft. in diameter; its exterior is covered with a thick cork-like substance, which cracks and forms many-sided protuberances, separated by deep fissures, giving the whole much the appearance of the shell of a large tortoise; the brown color and apparently lifeless character of this mass form a striking contrast with the vigor and lively green of the rest of the plant. The dormant rootstocks as imported from Africa are to all appearance dead, but when placed upon the ground soon throw out small roots from the lower surface, and stems start from the upper surface and grow very rapidly. When not growing, the plant is kept quite dry. It is called in Africa Hottentots' bread, but it is said that the natives do not eat it, though the fleshy interior of the rootstock affords food to baboons and other animals. One or two other species are known, but are not cultivated.

Tortoise Plant (Testudinaria elephantipes).

**TORTOLA**, the most important of the Virgin group of West India islands, belonging to

Great Britain, lying between Virgin Gorda and St. John's, in lat. 18° 24′ N., lon. 64° 32′ W.; area, 26 sq. m.; pop. about 4,000. It is 12 m. long by 2 to 4 m. broad, and has a rough surface, rising to the height of over 1,600 ft. On the north, at Tortola, the chief town, is an excellent land-locked harbor. It exports sugar, molasses, rum, and copper ore. It is the seat of the lieutenant governor and the administrative council. The climate is unhealthful. (See VIRGIN ISLANDS.)

**TORTOSA** (anc. *Dertosa*), a walled city of Catalonia, Spain, in the province and 41 m. S. W. of the city of Tarragona, on the left bank of the Ebro; pop. about 25,000. It is on the slope of a hill, and is entered by three gates; the streets are narrow, ill paved, and some of them very steep. It has a Gothic cathedral, a theological seminary, and numerous churches and schools. Cotton and linen goods, glass, earthenware, cordage, wax candles, leather, soap, brandy, starch, and baskets are manufactured. The river is navigable for vessels of 100 tons, and there is considerable trade. There are quarries of valuable marble, known as Tortosa jasper, about 3 m. from the city.—The town enjoyed the privilege of a Roman *municipium*. It was early taken by the Moors, but was wrested from them in 811 by Louis le Débonnaire. They afterward retook it, and it became a harbor of pirates. A crusade was proclaimed against it in 1148 by Pope Eugenius III., and it was captured. The Moors made desperate efforts to retake it, but the Christian women defended the walls while the men sallied out and put the besiegers to flight. Many privileges were conferred upon the women for their bravery, and in 1170 the military order of La Hacha, or the Flambeau, was instituted for them. The French took Tortosa in 1708, and again at the beginning of 1811.

**TORTUGAS. I.** See DRY TORTUGAS. **II.** An island of the West Indies, off the N. E. coast of Cuba, from which it is separated only by a narrow channel called El Savinal. It forms the entrance to the harbor of Nuevitas, and is about 25 m. long from N. W. to S. E. and 6 m. wide.—Several smaller islands are called Tortuga or Tortue (Sp. and Fr., a tortoise) from their shape, or from abounding in tortoises.

**TORTURE,** properly, an infliction of severe pain upon an accused person to induce a confession of guilt, or upon a criminal to extort a revelation of his accomplices. The term is frequently used carelessly to designate severe and unusual punishment inflicted for crime, but improperly, as it is never spoken of by judicial writers as a punishment. By legal writers on the continent of Europe and the earlier English authors, the word question (Lat. *quæstio*, a seeking) is used as a synonyme of torture; the object being a search for the truth in regard to the criminality of the tortured person, or the names of his accomplices, by the compulsion of suffering. Torture was divided as to intensity into the "question ordinary," a comparatively mild application of the instruments used in torturing, and the "question extraordinary," where these means were used to the greatest extent compatible with the preservation of life. The threats of torture were divided into "verbal territion," when the executioner described the torture, and "real territion," when the victim was placed upon the rack but not tortured. As to the time of its application, it was called the "question preparatory" when used for the purpose of compelling the accused to confess his own crime, and the "question *préalable* or preliminary" when applied to extort from a criminal the revelation of his accomplices.—Torture seems to have been early practised as a means of discovering guilt, both judicially and privately, but was not inflicted on freemen or citizens till the time of the Roman emperors, except in cases of suspected crime against the state itself. The Greeks inflicted it on their slaves, and after their subjugation by the Romans it was inflicted on those who had not a claim to the name of Roman citizen; the oath of the citizen was considered sufficient. Under the emperors this distinction was not long continued, and men and women even of patrician birth were subjected to torture to compel confession of crimes existing only in the imagination of tyrants. Wherever the code of Justinian was adopted as the basis of the legal system of European nations during the middle ages, judicial torture formed a feature of the examination of persons accused of crime; in the Teutonic nations it gradually took the place of ordeals and the trial by battle. In England it was probably never considered a part of the common law, though the *peine forte et dure*, which was used to compel a prisoner to plead to the indictment, had certainly some countenance from that law. (See PEINE FORTE ET DURE.) But it was recognized as one of the prerogatives of the crown to order it, and was thus in occasional use up to 1640, when the last case occurred. Severe and cruel as were the punishments inflicted by the ecclesiastical law, there is no evidence of a resort to "the question" by the inquisition or any other ecclesiastical court before 1252, when Innocent IV. called upon the civil arm to use it to induce confessions and accusations by offenders. Not long after this period the necessity of secrecy in the proceedings of the inquisition led to its extensive adoption, and to refinements of cruelty in its use before unknown. Judicial torture continued in most of the European states till the latter part of the last century. In 1780 the "question preparatory" was discontinued by a decree of Louis XVI., and in 1789 torture in general was abolished throughout the French dominions. In Russia it was abolished in 1801. In Austria, Prussia, and Saxony it was suspended soon after the middle of the last century, but in several of the smaller German states it continued on the statute books till the present century. Thomasius, Hommel, Voltaire, Beccaria, and Howard were instrumental

in bringing about its discontinuance. In the United States torture has never been reckoned an adjunct of judicial examination, though there are traces of the belief in its necessity among the lower classes in some of the early colonial enactments.—Among the Romans, the scourge was the usual instrument of torture; the *equuleus*, a sort of upright rack, was an invention of the Romans used upon their slaves, to which pincers to tear the flesh, fire, &c., were added. The rack as used in the tower of London was of uncertain origin; it consisted of an open frame of oak under which the prisoner was laid on his back, and his wrists and ankles fastened by ropes to rollers at the end of the frame, which were tightened by means of a ratchet wheel till the whole body was brought to a level with the top of the rollers, and in the "question extraordinary" till the joints were dislocated. The "boot" was the favorite French instrument of torture; in this rings of iron were passed around the legs, and wooden wedges driven between them and the flesh till the muscles were reduced to jelly. Among other instruments used to test the power of human endurance were the thumbscrew; iron gauntlets; the "little ease," a narrow cell in which the prisoner was confined for several days, and in which the only position possible was one which soon cramped every muscle; the "scavenger's daughter" (a corruption of "Skevington's daughter"), an instrument invented by Sir William Skevington, which so compressed the body as to start the blood from the nostrils, and often also from the hands and feet; the torture by water; and numerous other inventions capable of producing intense suffering.—For those forms of punishment which aimed at making the penalties of crime terrible by the intensity of the physical suffering they inflicted, ingenuity seemingly exhausted its powers. Crucifixion, fastening to the cross with cords, and anointing the body with honey that insects might torment the helpless victim, hanging up in a cage, suspending the culprit by the arms while weights were tied to the feet, the fastening of limbs to trees which were forced into proximity to each other and then suffered to fly apart, pouring melted lead into the ears, immersing one or more limbs or the whole body in boiling oil, suspending over a slow fire, plucking out the hair in masses, slitting the nostrils and lips, putting out the eyes, cropping, cutting off the hands, branding, mutilation, crushing the body with heavy weights, starvation, deprivation of air, confinement in *oubliettes* or bottle-like prisons without ventilation, pulling out the nails, and breaking on the wheel, are a few of the many means by which punishment has been inflicted, often for offences of a secondary grade, within the past 200 years. To the same writers who effected the discontinuance of torture, is due in a great degree also the abolition of these cruel punishments.—See Jardine, "On the Use of Torture in the Criminal Law of England" (8vo, London, 1839); Maclaurin, "Introduction to Criminal Trials;" Augustin Nicolas, *Si la torture est un moyen sûr à vérifier les crimes secrets* (12mo, 1681); Reitemaier, *Sur la question chez les Grecs et les Romains;* and Mittermaier, *Das Deutsche Strafverfahren*, vol. i.

**TORY.** See Whig and Tory.

**TOSCHI, Paolo**, an Italian engraver, born in Parma about 1788, died there in 1854. He studied in Paris, returning in 1819 to Parma as director of the academy of fine arts. He was the first to engrave Correggio's frescoes, of which he completed 22 plates with the aid of his pupils, who continued the work after his death; the whole number is to be 48, and 18 additional had been finished in 1874.

**TOTAL ABSTINENCE.** As early as 1639 a law was made in Massachusetts to restrain intemperate drinking, and similar laws were passed about the same time in Connecticut. In 1760 the religious societies began to protest against the use of liquors at funerals. In 1756 a duty was laid upon imported spirits in Pennsylvania for the purpose of diminishing their consumption, and in 1772 this act was extended to embrace spirits of domestic production. The first continental congress, in 1774, recommended "the several legislatures of the United States immediately to pass laws the most effectual for putting an immediate stop to the pernicious practice of distilling, by which the most extensive evils are likely to be derived if not quickly prevented." The first modern temperance society was formed in 1789 by 200 farmers of Litchfield, Conn., who, to discourage the use of spirituous liquors, "determined not to use any distilled liquors in doing their farm work the ensuing season." In December, 1790, the college of physicians in Philadelphia memorialized congress "to impose such heavy duties upon distilled spirits as shall be effectual to restrain their intemperate use in our country." The Methodist church from its foundation in America took decided ground against the use and sale of liquors. In the latter part of the 18th century the clergy in general began to make active efforts against intemperance. The cause of temperance was also publicly advocated by philanthropists, chief among whom was Dr. Benjamin Rush. But the modern temperance movement may be said to date from 1811, when the efforts for the suppression of intemperance assumed an organized and systematic form, although for 25 years thereafter but limited results were apparent. In that year the general assembly of the Presbyterian church appointed a committee of seven ministers to devise measures for preventing the evils arising from the intemperate use of spirituous liquors. In 1812 this committee recommended that all Presbyterian ministers in the United States should deliver discourses on the evils of intemperance, and that extended efforts should be made to circulate addresses, sermons, tracts, and other printed matter on this subject. In June, 1811, the

general association of Massachusetts appointed a committee of four ministers and four laymen to coöperate with the committee of the general assembly of the Presbyterian church and the general association of Connecticut in devising measures for the promotion of temperance. In 1813 this committee organized the "Massachusetts Society for the Suppression of Intemperance," which in 1833 changed its name to that of the "Massachusetts Temperance Society," under which title it was incorporated in 1845 and still holds a corporate existence. In 1826 the "American Society for the Promotion of Temperance" was formed in Boston, with Marcus Morton as president. Dr. Justin Edwards of Andover, Mass., became the corresponding secretary in 1829, and travelled extensively, preaching total abstinence and organizing state and local societies. The five annual reports of the society written by him are among the best contributions to the literature of this subject. In 1836 the society became by change of name the "American Temperance Union," with the Rev. Dr. John Marsh as secretary. It was then established in Philadelphia, but in October, 1838, was removed to New York. Although total abstinence was publicly advocated as early as 1820, it was not till many years later that any of the temperance organizations insisted upon this requirement. The object of the Massachusetts society, as set forth in its constitution, was "to discountenance and suppress the too free use of ardent spirits." Neither the American temperance society nor its auxiliaries opposed the use of wine, cider, or malt liquors. Total abstinence from distilled spirits, except when prescribed as a medicine, and moderation in the use of the less intoxicating drinks, were the only general requirements. Many of the earlier advocates of temperance, including Mathew Carey, encouraged the culture of the grape and the use of wine as a preventive of intemperance. Dr. Marsh, in his "Fifty Years' Tribute to the Cause of Temperance," says: "The first reformers built a brewery in Boston for the accommodation of members of the temperance society." Even the first national temperance convention, which assembled in Philadelphia in May, 1833, and was composed of 400 delegates from 21 states, including a large number of clergymen of all denominations, simply took the ground that "the traffic in ardent spirits as a drink, and the use of it as such, are morally wrong, and ought to be abandoned throughout the world." Nothing was said of total abstinence from other alcoholic beverages. At this convention the "United States Temperance Union" was formed, consisting of the officers of the American temperance society of Boston, 23 state societies, and more than 7,000 minor associations. Its object was, by diffusing information and exerting a moral influence, to extend the principles of temperance throughout the world. In 1833 the Massachusetts society adopted a new constitution with a pledge of total abstinence. In 1836 the state society of Pennsylvania, formed in 1827, adopted the pledge of "total abstinence from all that can intoxicate." Demand was now made in all the states that higher ground should be taken; yet few were prepared to include malt liquors in the pledge, believing that beer was necessary and beneficial. The second national convention was held at Saratoga, N. Y., in 1836, when the name of the United States temperance union was changed to that of the "American Temperance Union," with the design of admitting members from all parts of North America. The convention was attended by 348 delegates from 19 states and territories and from Canada. The most marked feature of the proceedings was the adoption of the principle of total abstinence from all intoxicating drinks as beverages. One of the earliest state societies was that of Connecticut, organized in May, 1829. In the same year state temperance societies were formed in New Hampshire, Vermont, New York, Virginia, and Illinois. In May, 1831, there were 19 state societies, with 2,200 known local societies formed on the plan of total abstinence, and embracing more than 170,000 pledged members. In 1832 the war department abolished the "grog" ration, substituting coffee and sugar.—As early as 1832 the license question began to be agitated, and a strong public opinion against license laws was soon formed. In 1837–'8 a bill introduced in the Maine legislature to repeal all license laws of the state, and to forbid the sale of ardent spirits as a beverage in less quantity than 28 gallons, was lost by one vote in the senate. In Tennessee a law was passed repealing all acts licensing tippling houses, and making the retailing of spirits a misdemeanor punishable by fine at the discretion of the courts. In Massachusetts the sale of spirituous liquors in less quantity than 15 gallons, except by physicians and apothecaries, was forbidden. Laws were also passed in Connecticut, Rhode Island, and New Hampshire, either restricting the sale or leaving it to a vote of the people of each town whether liquor selling should be licensed. The third national convention, composed of 560 delegates, assembled in July, 1841, and resolved "that the license laws are at variance with all true political economy, and one of the chief supports of intemperance." Large conventions in Maine, New Hampshire, and Massachusetts declared against granting licenses, and in favor of providing by fine and imprisonment for the effectual suppression of the traffic. In 1846 New York voted against license by a large majority. Vermont gave a majority of 8,000 against license, and many towns in New Hampshire voted against it. In Rhode Island every town but three, and in Connecticut two thirds of the towns, declared in favor of "no license." In Pennsylvania 18 counties voted on the question, and generally against license. In Ohio, Indiana, Michigan, Iowa, and Wis-

consin about half of the counties opposed it. The agitation of the question of license resulted in a strong public sentiment in favor of prohibition. In March, 1847, the supreme court of the United States unanimously decided that prohibitory laws "were not inconsistent with the constitution of the United States, nor with any acts of congress;" and that it was within the police powers of the states to restrain or prohibit the traffic in intoxicating drinks. Maine was the first state to prohibit by law the sale of strong drinks. A prohibitory law was enacted in that state in 1846, with only ordinary fines for its violation. The "Maine law," drafted by Gen. Neal Dow, provided for the seizure and destruction of liquors held for illegal sale; fine and imprisonment for the illegal manufacture or sale of liquors were prescribed in 1851. This law was repealed in 1856, and a stringent license law substituted; but after an experience of two years of license, with increase of poverty, crime, and public disorder, contrasted with the previous years of prohibition, an enactment was passed and submitted to the people, and prohibition again became the policy of the state, being ratified by a majority of 22,952. Delaware was the second state to enact a prohibitory law, which was submitted to the people and ratified in 1847; but in 1848 it was declared unconstitutional by the supreme court for being so submitted. In May, 1852, Rhode Island passed a prohibitory law, which was declared unconstitutional by Judge Curtis of the United States circuit court. It was amended in January, 1853, and was repealed in 1863. In 1865 a law was passed allowing town councils and boards of aldermen to grant or refuse licenses. In 1874 the license clause was repealed, and prohibition reënacted; but in June, 1875, the prohibitory clause was again repealed. Massachusetts passed a prohibitory law in 1852, which was declared unconstitutional in some of its provisions, and a new law was passed in 1855, which remained till 1868, when it was repealed and license substituted; but the prohibitory law was again enacted in 1869, cider being excepted. In 1870 the law was altered to allow the free sale of lager beer, ale, porter, and strong beer, in every town in the state where the citizens did not vote to prohibit it; but in 1871 the law was again changed so that malt liquors might not be sold in towns without a vote in its favor, cider being still exempt. In 1873 the beer clause was repealed, thus restoring the prohibition of both malt and spirituous liquors; but as apothecaries were permitted to sell, the law of 1855 and 1857 was not fully restored. In 1875 the prohibitory clause of the law was repealed, and license substituted. The Vermont legislature in 1852 passed a prohibitory law, which was ratified by the people in 1853, and still remains. In 1850 Michigan prohibited the sale of liquor by a constitutional provision; and in 1853 a prohibitory law was enacted and ratified by a popular majority of 20,000. In 1854 the law was pronounced unconstitutional by half of the judges of the supreme court, because it had been submitted to the people. The law was reënacted in 1855, and was changed seven times previous to 1875, when the prohibitory law was repealed and a tax law substituted. In 1853 Chief Justice Williams of Connecticut drafted a prohibitory law, which was passed by the legislature, but was vetoed by Governor Seymour. But in 1854 a bill was passed prohibiting the sale of liquors by a vote of 13 to 1 in the senate and 148 to 61 in the house. It was repealed in 1872. A prohibitory law was enacted in Indiana in 1853, with a clause providing for its submission to the people, which the supreme court pronounced unconstitutional. In 1855 another prohibitory law was passed, but it became null because the supreme court was equally divided as to its constitutionality. In Iowa a prohibitory law was passed by the legislature in 1855, and ratified by the people. This law still exists, with some modifications in regard to fermented liquors. The New York legislature passed a strong prohibitory law in 1854, which was vetoed by Governor Seymour. The next year the law was again passed, and its constitutionality was affirmed by the court of appeals in 1856. In New York city the mayor did not attempt to enforce it. New Hampshire passed a prohibitory law in 1855, which is still in force. Illinois also passed a prohibitory law, with a clause providing for submitting it to a vote of the people, by whom it was defeated.—The fourth national convention assembled in 1851 at Saratoga, and passed resolutions in favor of prohibitory laws, and advised that an appeal should be made to the people in states where the legislature would not enact such a law. The fifth convention, held in 1865, recommended the use of unfermented wine by the churches in the communion, deprecated the use of alcoholic liquors as a medicine, and urged the medical profession "to substitute other articles in the place of alcohol as far as in their judgment it can be wisely done." A committee appointed by this convention organized in 1865 the "National Temperance Society and Publication House," which has its headquarters in New York, and is engaged in the publication and distribution of temperance literature. The sixth convention, at Cleveland, Ohio, in 1868, urged the friends of the cause "to refuse to vote for any candidate who denies the application of the just powers of civil government to the suppression of the liquor traffic." The seventh convention, held at Saratoga in 1873, declared "that the time had arrived to introduce the temperance issue into state and national politics," and "to coöperate with existing party organizations where such will indorse the legislative policy of prohibition and nominate candidates pledged to its support, otherwise to organize and maintain separate independent party action." The eighth

national convention was held in Chicago in 1875. It resolved "to nominate and vote for such candidates only, state and national, as will unqualifiedly indorse and sustain the prohibition of the liquor traffic," and "that whenever suitable nominations are not otherwise made, independent prohibition candidates be nominated." Political action was early taken by temperance organizations, many local officers being elected in various states as temperance candidates; and in 1854 the candidate of the temperance party for governor in New York, Myron H. Clark, was supported by the remnant of the whig party, and elected. In 1872 the Hon. James Black of Lancaster, Pa., was nominated for president, and received votes in New Hampshire, Connecticut, New York, Pennsylvania, Ohio, and Michigan.—*Total Abstinence Societies.* The "Washingtonian Temperance Society" was formed in Baltimore, April 5, 1840, by six men of intemperate habits, who signed a pledge of total abstinence with the determination to urge others to do the same. The number of members rapidly increased, and at the first anniversary of the society more than 1,000 reformed drunkards marched in procession. Similar societies were formed in various parts of the United States, and speakers travelled through many states, advocating the cause. It is estimated that 150,000 decidedly intemperate men signed the pledge and gave up drink. The first division of the "Sons of Temperance" was organized in New York city in 1842, by John W. and Isaac Oliver. The order increased with great rapidity, numerous divisions being organized in every state and territory, and in Canada and Great Britain. The strength of the order reached its maximum in 1850, when there were in the United States, Canada, and England 37 grand divisions and 6,097 subordinate divisions, with a total membership of 238,903. In 1873 there were 42 grand and 1,836 subordinate divisions, with 82,299 members; the number of members in Great Britain was 11,116. The basis of the organization is: 1, a strict adherence to the principles of total abstinence from all intoxicating drinks; 2, the payment of regular dues to form a common fund for coöperative temperance agitation, mutual aid in sickness and distress, and funeral expenses. The "Temple of Honor and Temperance" was organized by prominent sons of temperance, and designed as a higher branch of that order. The first temple was instituted in New York city in 1845; a national temple was organized in 1846. In 1848 all connection with the sons of temperance was severed, and the temple of honor assumed an independent position. In 1855 there were 343 temples, with 13,860 members. In 1874 there were 20 grand temples, with 315 subordinate and 110 inner temples, the total membership being 16,923. The order stands firmly by total abstinence as the only rule of personal duty, and prohibition as the true policy of the state. The "Independent Order of Good Templars" was formed in 1852, on the basis of total abstinence from all intoxicating liquors as a beverage, and the absolute prohibition by law of the manufacture, importation, and sale of intoxicating liquors for beverages. The society has passwords, signs, grips, and signals. There are four degrees: the subordinate degree, degree of fidelity, degree of charity, and grand lodge degree. Each grand lodge is the head or legislative body of the state or territory where it exists, and is composed of representatives from the subordinate lodges within the jurisdiction. The grand lodges meet annually and elect representatives to form the right worthy grand lodge, whose province is to legislate upon all matters of general interest to the whole order. In 1875 there were 60 grand lodges within the jurisdiction of the order; there are grand lodges in Great Britain, Canada, Australia, and elsewhere, besides subordinate lodges in China, India, Japan, France, Germany, Holland, Portugal, Africa, and the West Indies. The total membership is estimated at 735,000. In England, where the order has its greatest numerical strength, there are 3,618 lodges, with 166,708 members.—*Great Britain.* The temperance movement in Great Britain was begun by John Dunlop, a justice of the peace for Renfrewshire, who devoted himself to the cause in Scotland in 1828, and in 1829 formed the first temperance society near Glasgow. The first total abstinence society was organized at Dunfermline in 1830. In Ireland the cause was first advocated by the Rev. George Whitmore Carr, who organized a society at New Ross, county Wexford, in 1829. The first total abstinence society was formed at Strabane in 1835. Father Theobald Mathew began his labors at Cork in 1838, and soon extended them not only to all parts of Ireland, but to England and Scotland. The total abstinence society formed by him in 1838 contained 1,800,000 members in 1840. The consumption of whiskey in Ireland decreased from 12,500,000 gallons in 1838 to 6,500,000 gallons in 1841. In 1843 the number of persons pledged to total abstinence exceeded 5,000,000. The active movement against intemperance in England began in 1830, when the first society was formed at Bradford by Henry Forbes, a merchant. Other societies were organized during the same year at Warrington, Manchester, Liverpool, and Leeds; and in 1831 the "British and Foreign Temperance Society" was formed, with a pledge "to abstain from distilled spirits except for medicinal purposes." This society, which had for its patron the bishop of London, and among its vice presidents bishops, admirals, and other persons of high official rank, held for many years a prominent place in the temperance movement. At first these societies did not oppose the moderate use of wine and malt liquors. The first total abstinence society in England was formed at Preston in 1832.

In 1835 it was estimated that 48,000 persons had signed the pledge in England, and that 2,000 drunkards had been reformed. In 1835 the "British Association for the Promotion of Temperance" was formed in Manchester, on the principle of total abstinence, and the "British Teetotal Temperance Society" in London; in 1836 the latter was united with the "New British and Foreign Temperance Society for the Suppression of Intemperance." Weekly meetings were held in various parts of London, with great success. The moderation movement finally died out, and "teetotalism" was firmly established as the best means of suppressing intemperance. Up to 1839 the new British and foreign society had two pledges; in that year the American pledge of total abstinence was adopted. In 1840 the two general societies adopted the principle of total abstinence, and the cause spread rapidly throughout the United Kingdom. At this time about 500,000 members were enrolled in the societies of Great Britain, while the adherents to total abstinence numbered more than 2,000,000. In 1842 the two parent societies in London were dissolved, and the "National Temperance Society" was organized, which recognized all total abstinence societies, of whatever form of pledge. In 1843 Father Mathew visited London, and in six weeks administered the pledge to about 70,000 persons. In August, 1846, a world's temperance convention was held in London, and was attended by 300 delegates, including 25 from North America. The most marked progress was made by the temperance cause from 1851 to 1856. The "London Temperance League" held monthly meetings in Exeter hall, and free lectures were delivered in all parts of the city; 3,000 petitions were sent to parliament, and 30,000 tracts distributed. The "United Kingdom Alliance" was formed in 1853 for the "total and immediate suppression of the traffic in all intoxicating liquors as a beverage;" it has since prosecuted its labors with great vigor and success by means of lectures, petitions to parliament, publications, &c. The alliance has given its hearty support to the "permissive bill," which has often been brought forward in parliament in recent years, but without success. The object of the bill is to prohibit the granting of licenses to sell liquor whenever two thirds of the rate payers of any parish shall by vote so determine. Numerous organizations are now actively engaged in various parts of Great Britain in promoting the cause of temperance. Chief among these are: the "National Temperance League," formed in 1854 by a union of the national temperance society with the London temperance league; the "British Temperance League," whose operations are chiefly in Lancashire and Yorkshire, its headquarters being at Bolton; the "Western Temperance League," established in 1837 and reorganized in 1858, embracing 284 societies, the operations of which extend to nine English and three Welsh counties; the "North of England Temperance League," with 125 societies in Northumberland, Durham, Cumberland, Westmoreland, and the Cleveland district of Yorkshire; the "Irish Temperance League;" and the "Scottish Temperance League," which in 1873 had issued 70,000 volumes and 630,000 tracts, besides a weekly and a monthly periodical. The United Kingdom alliance has its executive council resident in Manchester. England and Wales are divided into districts superintended by resident agents. Its operations also extend to Scotland and Ireland in connection with the "Scottish Temperance and Permissive Bill Association," the "Irish Temperance and Permissive Bill League," and the "Irish Permissive Bill Association." The "National Association for promoting Amendment in the Laws relating to the Liquor Traffic" directs its efforts toward obtaining amendments of license laws. Various enactments have been passed by parliament, and committees of inquiry appointed with the view of diminishing the evils of intemperance. These efforts have been directed toward the restriction of the liquor traffic rather than its prohibition.

**TOTILA** (properly BADUILA), a Gothic king of Italy, died A. D. 552. He was duke of Friuli, and was chosen king in 541, after the surrender of Vitiges to the Byzantine forces at Ravenna. When Belisarius was withdrawn from the service against the Goths, Totila overran the greater part of Italy, and in 546 entered Rome by the treachery of some Isaurian sentries. He held peaceful possession of the city until compelled to leave it in order to repair the reverses his armies had sustained in Lucania. In his absence Rome was recovered by Belisarius, and in 547 Totila was repulsed in endeavoring to retake it. In 548 Belisarius was recalled to Constantinople, and Rome once more fell into the hands of Totila. In 552 Narses was sent into Italy by the emperor Justinian, and at Tagina in Umbria Totila's forces were defeated, and he was killed.

**TOUCAN**, a name given to the scansorial birds of the family *ramphastidæ*, derived from the Brazilian imitation of their note. The family is remarkable for the disproportionate size of the bill, which is very light on account of its spongy texture; it is strengthened internally by a network of thin bony laminæ freely supplied with vessels and nerves; it is broad at the base, without a cere, smooth, with the culmen curved, sides compressed, tip hooked, and the sides serrated; the tongue is long and slender, provided with numerous barbs on each side directed forward; the bill is usually adorned with bright colors, which fade after death; the tarsi covered with transverse scutes, the quills almost concealed under the large coverts, the tail with ten feathers; claws curved and sharp; toes two before and two behind; orbital region naked; furcula of two bony pieces, thin and not united below, and sternum with two deep incisions on each side

behind. They are peculiar to tropical America, living in flocks in the forest, where they make a great chattering as they hop from branch to branch in search of food; they feed principally on pulpy fruits, also on fish, eggs, larvæ, and small birds and reptiles; they also saw off the tubular corolla of flowers, picking out the insects with the horny, fimbriated tongue. When roosting they throw their tail upward and forward, and rest the enormous bill on the back. They are generally handsome birds, representing in America the hornbills of Asia and Africa; they are not powerful fliers, and are strictly arboreal, hopping among the branches with such grace and agility as to have suggested for one of them the specific name of Ariel. The nest is in holes in trees, and the eggs are two, rounded and white. They post a sentinel while they feed, whose warning cry resembles the word *tucano;* the skin is bluish, and the flesh eatable though rather tough; they sometimes commit great havoc with fruit, and are often killed for food and for their brilliant feathers; they are very sensitive to cold.—In the toucans proper (*ramphastos*, Linn.) the bill is higher and wider than the forehead, looking as if too large for the head and belonging to another bird; the nostrils are hidden behind the prominent base; wings short and rounded, with the first four quills graduated and narrowed at the tip, and the fifth the longest; tail short and nearly even; feet short and stout; colors generally black with patches of white, red, and yellow, especially under the chin. The toco toucan (*R. toco*, Gmel.) is 17 in. long, and the bill is more than half of that length; plumage black with throat and rump white, vent red, bill orange red with black tip; it inhabits Guiana and Brazil. The yellow-breasted toucan (*R. tucanus*, Linn.) has a yellow throat, with red

Yellow Toucan (Pteroglossus Humboldtii).

vent and breast spot, and the rest of the plumage black. There are more than a dozen other species.—In the genus *pteroglossus* (Illig.), generally called aracaris, the bill is much smaller and sometimes not out of proportion to the head, as high as the forehead, with the nostrils conspicuous at the base; fourth, fifth, and sixth quills longest; tail long and graduated; the colors are usually green, with red or yellow on the breast. There are more than 30 species, with habits similar to those of the last genus. The aracari toucan (*P. aracari*, Illig.) is 17 in. long, with a bill of 4 in.; plumage blackish green, with yellowish abdomen, red median abdominal bar and rump; upper mandible with a longitudinal black stripe. The yellow toucan (*P. Humboldtii*, Gould) is 17 in. long, black and olive with a scarlet rump, and the under surface yellow; it is found on the upper Amazon.—For description and figures of this family, see Gould's "Monograph of the Ramphastidæ" (fol., London, 1834).

**TOUCH,** the modification of the common sensibility of the body, especially seated in the skin, by which through physical contact we obtain an idea of resistance or weight, temperature, size, shape, smoothness or roughness, &c. It is most acute at the tips of the fingers, on the tongue, lips, portions of the mucous membrane, and the nipples, where the sensory papillæ are the most numerous, each one receiving one or more nerve fibres. The nerve fibres appear to terminate in what has been called the tactile corpuscle in the interior of the papilla. All the afferent nerves of the general integument apparently minister to the sense of touch, by virtue of their connection with the seat of common sensation in the brain; those of the lower extremities are less concerned in conveying sensations than those of the upper, though they are far more efficient in exciting the reflex action of the spinal cord. The acuteness of touch differs in various parts of the body, generally in proportion to their vascularity; the non-vascular parts, like the hair, nails, and teeth, have no sense of touch, while on the skin the nerves are spread in a minute network. Its relative acuteness has been measured by Weber, by placing the legs of a pair of compasses on the skin, and approximating them until brought within the smallest distance at which they could be felt as distinct points, and with the following results: the point of the tongue, ½ line; palmar surface of third finger, 1 line; red surface of lips, 2 lines; tip of nose, 3 lines; edge of dorsum of tongue, 4 lines; skin of cheek, palm of hand, and end of great toe, 5 lines; back of hand, 8 to 14 lines; back of foot, 18 lines; over spine, and in middle of arm and thigh, 30 lines. There are considerable variations in this respect in different individuals. The feeling of tickling is most easily excited in parts having a feeble sense of touch, as the arm pits, sides below the ribs, palms, and soles, while the sensitive points of the fingers cannot thus be affected. This sense is exceedingly acute in the flying membrane of the bats and in the whiskers of the carnivora and rodents. It is combined with movement in the human hand, with its power

of pronation and supination, opposability of the thumb, and great mobility of the fingers. The power of distinguishing the temperature of foreign bodies is restricted within certain rather narrow limits. We can perceive the temperature of a substance which is moderately warm or cool; but if it be either above or below a certain limit, we fail to judge accurately of its temperature, and receive only a painful sensation. If the foreign body be excessively hot or cold, as in the case of boiling water or frozen mercury, the discrimination of temperature is lost altogether, and the painful sensation is the same in either instance. Thus the touch of a very cold conducting body may be said to burn the fingers, like that of a very hot one. Cold, by retarding the capillary circulation and by its direct sedative influence, deadens the sense of touch; in like manner, pressure upon or disease of the nerve trunks, and various states of the brain receiving the sensory impressions, are accompanied by obtuseness of touch. Prominent among the causes acting on the nervous centres are the influence of toxic and anæsthetic agents, obstructed circulation, and chronic inflammations; on the other hand, irritation and acute inflammation in the course of the nerves, at their peripheral terminations, or in the centres, may be accompanied by hyperæsthesia or excessive sensitiveness of the surface. Subjective sensations, or those dependent on internal causes, are very common in the sense of touch; those of pleasure and pain, heat and cold, itching and creeping sensations, &c., are familiar examples. Touch may be greatly improved when the other senses are impaired or lost, partly from the greater attention given to the sensations, and the consequent increase of the power of discrimination. Instances of the education of this sense are very remarkable and well known in the blind. In the lower animals it is most acute in the hands, feet, and prehensile tail of monkeys; in the lips and tongue of herbivora; in the snout of the elephant, pig, tapir, and mole; in the flying membrane, ears, and nasal appendages of bats, which can perceive even the vibrations of air; in birds, in the under surface of the toes and their webs, and in the sensitive skin of the mandibles of the duck tribe and some waders; in the under surface of the toes in many lizards, in the extensile tongue of the chameleon and serpents, in the naked skin of batrachians, and in the thumbs of the males of the latter during the reproductive season; in the antennæ and palpi of articulates, in the oral appendages of mollusks, and in the tentacles of radiates.

**TOUL** (anc. *Tullum*), a fortified town of French Lorraine, in the department of Meurthe-et-Moselle, on the Moselle, 14 m. W. of Nancy; pop. in 1872, 6,584. It has a celebrated Gothic cathedral, and other notable buildings are the church of St. Genoult and the former episcopal palace, now used as a town hall. Its trade and industry embrace wine, glass, hosiery, and other local products and manufactures.—Originally it belonged to Belgic Gaul, and afterward successively to Austrasia, to local counts, and to Germany as an imperial city under the protectorate of the dukes of Lorraine; and in the middle of the 16th century it was annexed to France. The bishopric, established early in the 5th century, was suppressed during the revolution. In January, 1814, Toul was stormed by the Russians; and in 1870 it was bombarded by the Germans, to whom it surrendered Sept. 23, after a strenuous defence.

**TOULMIN, Camilla.** See CROSLAND.

**TOULMIN, Joshua**, an English clergyman, born in London, May 11, 1740, died in Birmingham, July 23, 1815. He was educated at a dissenting academy, and became pastor of a dissenting congregation in Colyton, and in 1765 of a Baptist congregation in Taunton, where he was also a bookseller. He subsequently adopted Unitarian opinions, received the degree of D.D. from Harvard college in 1794, and in 1804 was chosen one of the ministers of the Unitarian congregation at Birmingham, formerly presided over by Dr. Priestley, which post he retained till his death. His principal publications are: "Sermons to Youth" (12mo, Honiton, 1770); "Memoirs of Socinus" (1777); "Letter to Dr. John Sturges on the Church Establishment" (1782); "Dissertations on the Internal Evidences of Christianity" (1785); "Review of the Life, Character, and Writings of John Biddle, M.A." (1789); an edition of Neal's "History of the Puritans," with notes and additions (5 vols., 1794–'7; 3 vols., 1837); "Biographical Tribute to the Memory of Dr. Priestley" (1804); "Memoirs of the Rev. Samuel Bourne" (1809); and a "Historical View of the State of the Protestant Dissenters in England" (1814). Theophilus Browne edited and published 22 of his posthumous discourses (8vo, Birmingham, 1818).

**TOULON**, a seaport city of France, in the department of Var, Provence, at the head of a double bay of the Mediterranean, in lat. 43° 7′ N., lon. 5° 56′ E., 30 m. S. E. of Marseilles; pop. in 1872, 69,127. It stands upon ground which rises gradually from the sea, and is sheltered by a ridge of mountains, extending round the bay. A tongue of land stretches nearly across the entrance of the bay, and, together with all the adjacent points, is strongly fortified. The city has been much enlarged within the last generation, and the new northern quarter is a great improvement upon the old parts of the town. It is especially rich in fountains, trees, and promenades. The cathedral and other old and new churches, the fine town hall, the military and naval schools, as well as the new palace of justice and the new theatre, are all eclipsed by the magnitude of the military port. It is the largest in the Mediterranean and one of the most admirable of the kind, extending over 240 acres, and surrounded by vast buildings, the arsenal, and floating docks, and connected with the supplementary arsenals of Cas-

tigneau and Mourillon; and it contains a bagnio for prisoners sentenced to transportation. The adjoining commercial port is bounded by a quay, which is the most active part of Toulon. Ship building is largely carried on, but trade and industry are chiefly supported by the military and naval works, which employ 10,000 men.—Toulon was known as a harbor under the Romans, then called Telo Martius. In the middle ages it suffered from the Saracens. The fortifications were first projected as a defence against pirates. Under Louis XIV. they became celebrated, withstanding in 1707 a combined attack by the English and Dutch fleets and a land army under Prince Eugene; and they were extended under Napoleon III. In 1793 the English gained possession of Toulon, but were besieged by the troops of the convention, and finally driven out (Dec. 19), under the direction of Bonaparte, who first established his reputation on this occasion. In revenge for the previous surrender of the royalist inhabitants to a foreign power, the town was given up to pillage and massacre.

Toulon.

**TOULOUSE** (anc. *Tolosa*), a city of France, in Languedoc, capital of the department of Haute-Garonne, on the Garonne, 130 m. S. E. of Bordeaux; pop. in 1872, 124,852. It includes an island in the river, and the suburb of St. Cyprien, where 25,000 workmen resided before its destruction by the floods of 1875. It is more remarkable for historical associations and for its active industry than for external attractions. The square is called after the capitol or town hall, where the once famous floral games are still annually held under the auspices of a literary society. The church of St. Sernin is more remarkable than the cathedral, and is a masterpiece of Romanesque architecture, recently restored by Viollet-Leduc. The church of the Cordeliers, of the 13th century, was destroyed by fire in 1871. Toulouse has one of the richest museums of art, located in a former monastery, and various learned institutions, a public library of 60,000 volumes, an observatory, and an arsenal. The palace of justice was formerly the seat of the Toulouse parliament. The trade with both the Mediterranean and the Atlantic is active. Woollen and cotton goods, cutlery, hardware, and many other articles are manufactured.—Toulouse is of great antiquity. It became the capital of the Visigoths in the 5th century, and subsequently of the duchy of Aquitaine. Local counts or dukes were the rulers from the end of the 8th till late in the 13th century, in the early part of

Church of St. Sernin.

which a crusade was carried on against Counts Raymond VI. and Raymond VII. (See ALBIGENSES.) Philip III. annexed it to the French crown, under which it remained the capital of Languedoc till the revolution. During the mid-

dle ages it was the seat of numerous councils. The memorable battle of Toulouse, April 10, 1814, resulted in Wellington's signal victory over the French under Soult. The inundation of the Garonne on June 24, 1875, caused the loss of a vast number of lives and immense property.

**TOURAINE,** an ancient province of France, now chiefly comprised in the department of Indre-et-Loire. It was originally inhabited by the Turones, a Gallic tribe. At the end of the 5th century Clovis took it from the Visigoths. Having been governed for a time by local counts, it passed in 1044 to the house of Anjou, and with this subsequently under English domination. In 1202 it was taken by the French king Philip Augustus. It was a duchy from 1356 till its final annexation in 1584 to the French crown. Tours was at all times the capital of Touraine. (See Indre-et-Loire.)

**TOURCOING,** a town of France, in the department of Le Nord, 8 m. N. E. of Lille, within a few miles of the Belgian frontier; pop. in 1872, 43,322. It contains very extensive manufactories of woollens, cottons, linens, carpets, and other goods. The aggregate number of spindles is about 400,000. A pyramid commemorates the battle of May 18, 1794, in which the army of Pichegru defeated the English.

**TOURGEE, Albion Winegar.** See p. 910.

**TOURMALINE,** a name applied to a group of rhombohedral double silicates, composed of silica, fluorine, boric acid, alumina, manganic, ferric, and ferrous oxides, magnesia, lime, soda, potash, lithia, and sometimes phosphoric acid. Rammelsberg divides them into magnesium, magnesium-iron, iron, iron-manganese, and manganese tourmalines, the last two varieties alone containing lithia. The sesquioxides are alumina and ferric and manganic oxides. The color of tourmalines varies with their composition; the red, called rubellite, are manganese tourmalines, containing lithium and manganese, with little or no iron; the violet blue (called indicolite) and green are iron-manganese tourmalines; and the black, which are schorl, are either iron or magnesium-iron tourmalines. White or colorless tourmalines, which are rare, are called achroite. Sometimes the crystals are red at one extremity and green at the other, or green internally and red externally, or *vice versa.* Tourmaline is usually found in granite, gneiss, and syenite, in mica, chloritic, and talcose schists, in dolomite, granular limestone, and sometimes sandstone near dikes of igneous rocks (Dana). Rubellite and green tourmaline are found at Yekaterinburg in the Ural mountains; pink crystals in the island of Elba; pale yellowish brown in Carinthia; white in the St. Gothard mountains, the Ural, and Elba. In Massachusetts, at Chesterfield, are red, green, and blue tourmalines, in a granite vein with albite; and at Goshen the blue occurs in great perfection. At Grafton and Orford, N. H., Brattleboro, Vt., and Monroe, Conn., specimens of tourmaline of various colors occur in steatite, mica slate, and other rocks. Tourmalines are found in New York, at Crown Point, in fine brown crystals, and in St. Lawrence, Jefferson, Essex, and other counties; also in other states, in numerous localities. In California black crystals, 6 to 8 in. in diameter, occur in feldspar veins in the mountains between San Diego and the Colorado desert. In Canada, superb greenish yellow crystals an inch in diameter occur in limestone at Grand Calumet island. In the town of Paris, Maine, in one of the spurs of "Streaked mountain" called by the mineralogists Mt. Mica, several deposits of beautiful green and red tourmalines of perfect forms were found in 1820 by Elijah L. Hamlin and Ezekiel Jones. Many specimens were sent to various parts of Europe; and some fine ones obtained from Vander Null, an antiquary, are believed to be in the museum at Vienna.—Tourmalines are not often used in jewelry, although fine rubellites form beautiful gems, and bear a high price. In the grand duke's collection at Florence there was a specimen 11 in. square, with four erect green tourmalines and one prostrate, 4, 2, and 2¼ in. long and ¾ in. to 1 in. thick. A magnificent group of pink tourmalines nearly a foot square was given by the king of Burmah to Col. Sykes, while commissioner to his court. The tourmaline appears to have been first brought to Europe from Ceylon by the Dutch about the end of the 17th century, and was exhibited as a curiosity on account of its pyro-electric properties, whence it was called *aschentrecker* (Ger. *Aschenzieher*). The tourmaline is a double-refracting crystal, but has the peculiar property of polarizing light. It has not the power like Iceland spar of separating and transmitting both the ordinary and the extraordinary ray; but when the plate is cut with its faces parallel to the optic axis of the crystal, and exposed to a ray of light, the ordinary ray passes through, while the extraordinary ray is absorbed. (See Light, vol. x., pp. 446 and 449, and Thermo-Electricity.)—See "Diamonds and Precious Stones," by Harry Emanuel (London, 1867; New York, 1873); "The Tourmaline," by A. C. Hamlin, M. D. (Boston, 1873); and Dana's "Mineralogy."

**TOURNAMENT** (It. *torniamento;* Fr. *tourner*, to turn), a military sport of the middle ages. It took its rise after the establishment of the feudal system, and appears to have been introduced into northern Europe as early as the middle of the 9th century, although several centuries elapsed before it came into familiar or reputable use. This was owing perhaps to the costliness as well as the sanguinary character of the contests in the early tournaments, which often resulted in the death or serious injury of several of the combatants, and were conducted very much in the spirit of the gladiatorial shows of the ancient Romans. Hence the prohibition of the practice by such princes as Henry II. of England, and the steady opposition of the church down to a late period.

With the institution of chivalry and knighthood, however, the tournament lost many of its objectionable features; and as an incentive to martial exploits and to a generous emulation in all knightly offices, it began during the period of the crusades to be tolerated, and eventually was encouraged in most countries of Christendom. The church, which had prohibited persons from engaging in tournaments on pain of excommunication, and had denied Christian burial to such as lost their lives in them, finally relaxed its opposition, and until the latter part of the 15th century the sport continued in full activity. It thenceforth became gradually transformed into a court pageant, often of the most magnificent and costly description; but the death of Henry II. of France of a wound received at a tournament in 1559 occasioned its abolition in all parts of Europe, although for nearly a century later it continued to be occasionally revived at court festivities. The decay of chivalry, the introduction of firearms, and the gradual disuse of defensive armor, together with the rise of the commercial spirit and the new civilization thereby extended over the world, were the real causes of its decline. Whatever may have been the nature of the combats in tournaments at the origin of the practice, they soon became for the most part encounters between mounted adversaries (whence the derivation of the term, as illustrative of the agility required by the combatants in turning or managing their horses), who were knights or at least candidates for knighthood, as esquires or pages. A joust was, properly speaking, a combat between two knights, while the tournament included several jousts, or an encounter of several knights on a side.—In the course of time numerous regulations, having the authority of a code of laws, prescribed the manner in which tournaments should be conducted; and, except where national pride or rivalry, or personal enmity, inflamed the combatants, no serious result was likely to happen. They were generally held at the invitation of some prince upon the birth or nuptials of royal persons, during royal progresses, or at high court festivals, and heralds were sent into the neighboring kingdoms to invite the knights to be present. These frequently came from distant countries, attended by splendid retinues; and on the appointed day the galleries encircling the lists, or level enclosed space in which the knights contended, were gay with banners and costly draperies and crowded with spectators, conspicuous among whom were the ladies, whose approving smiles were the rewards most esteemed by the victors. In the flourishing period of tournaments two kinds of arms were employed, those made expressly for the purpose, consisting of lances with the points blunted or covered with pieces of wood, called rockets, and swords blunted or rebated; and those ordinarily used in warfare, termed *armes à outrance*, which in many cases were not permitted by the judges of the tournament. The blows, whether of lance or sword, were required to be directed at the head and breast, and no combatant was permitted to strike an adversary after he had raised his visor, or to wound his horse. Each knight in attendance was obliged to prove his noble birth and rank, which were originally proclaimed by the heralds with sound of trumpet; whence the word blazonry, signifying the art of deciphering the heraldic devices on a coat of arms, from the German *blasen*, to blow. At a later period the emblazoned shields of the knights, suspended at the barriers or entrance of the lists, sufficed to indicate their rank and family. If upon the accusation of any lady present the bravery or loyalty of a knight was impeached, he was excluded by the heralds from the contest. The heralds having proclaimed the laws of the tournament, at the sound of the trumpet the whole body of knights, each with his attendant squire, entered the lists in a glittering cavalcade, distinguishable only by their emblazoned shields or by the favors of their mistresses suspended from their crests, after which the martial exercises of the tournament began. At the word of the heralds, *Laissez-aller*, the opposing combatants rode at each other in full career, striving to direct their lances fairly upon the helmet or shield of their adversaries, that one being adjudged the victor who broke most spears "as they ought to be broken," who held his seat the longest, and who showed most endurance in keeping his visor closed. Sometimes dismounted knights encountered each other with swords or axes. The prizes were announced by the judges, selected from the older knights, but were awarded by ladies.—A favorite form of the tournament was the so-called passage of arms, in which a party of knights, assuming the office of challengers, offered combat to all who dared oppose them. Of this, as also of the *mêlée* or encounter of bodies of knights attended by their squires, a splendid description is given in Scott's "Ivanhoe." The later tournaments were comparatively harmless.

**TOURNAY**, or **Tournai** (Flem. *Doornick*), a town of Belgium, in the province of Hainault, on both banks of the Scheldt, 45 m. S. W. of Brussels; pop. in 1870, 31,003. It has seven suburbs, fine streets and quays, a gymnasium, an episcopal seminary, an art academy, and many churches, including a cathedral with five towers and fine paintings. The church of St. Brice contains the tomb of Childeric I., and the "golden bees," supposed to have belonged to his royal robes, which Napoleon substituted for the *fleurs de lis* of the Bourbon vestments. Carpets, woollen cloths, hosiery, and linens are manufactured.—Under the Romans Tournay was included in Gallia Belgica under the name of Turnacum or Tornacum. In the 5th and 6th centuries it was a residence of the Merovingian dynasty. It afterward successively belonged to Flanders and France. In 1526 it was annexed to the Spanish Netherlands, and,

having espoused the Protestant cause, it was heroically though unsuccessfully defended in 1581 by Marie de Lalaing, princess of Épinoy, against the duke of Parma. It was conquered by Louis XIV. in 1667, and fortified by Vauban. The treaty of Utrecht (1713) gave it to Austria, but it was again under French rule from 1745 to 1748. The fortifications have recently been demolished.

**TOURNEFORT, Joseph Pitton de**, a French botanist, born in Aix, June 5, 1656, died in Paris near the close of 1708. After extensive studies and explorations he became in 1683 professor at the *jardin des plantes*, and was admitted to the academy of sciences in 1692. In 1700 he was sent by Louis XIV. on a scientific expedition to the Levant. He returned in 1702, and was subsequently professor of medicine in the collége de France. Linnæus has preserved several of his classifications. His works include *Éléments de botanique* (3 vols., Paris, 1694; new ed. of his Latin translation, with A. de Jussieu's additions, including his *corollarium* or classification of his vast collections, 3 vols., Lyons, 1719; English translation, 2 vols., London, 1719–'30); *Histoire des plantes qui naissent aux environs de Paris, avec leurs usages dans la médecine* (1698; enlarged ed. by Jussieu, 2 vols., 1725; English translation by Martyn, 2 vols., London, 1732); and *Voyage du Levant* (2 vols., 1717; English, 3 vols., 1741).

**TOURS** (anc. *Civitas Turonum* and *Cæsarodunum*), a city of France, capital of the department of Indre-et-Loire, chiefly on a tongue of land between the Loire and the Cher, 120 m. S. W. of Paris; pop. in 1872, 43,368. The bridge over the Loire is one of the finest in France. A handsome street traverses the town, and contains a marble statue of Descartes, who was born near Tours. Only two towers remain of the celebrated cathedral of St. Martin of Tours, destroyed in 1793. The palace of the resident archbishop is of uncommon beauty. The town hall has a large public library and remarkable manuscripts. Cloth, carpets, silks, and many other articles are manufactured.—Tours was the capital of the ancient tribe of Turones, under the Roman emperors of the latest period of Gallia Lugdunensis III., and lastly of Touraine. A number of important councils were held here, and the states general of France were repeatedly assembled here in the 15th and 16th centuries. The silk industry first arose here, and was of vast extent until the rise of Lyons. The town had a population of nearly 80,000 at the time of the revocation of the edict of Nantes, which ruined its prosperity. Several members of the government of the national defence, including Gambetta, had their seat in Tours during the siege of Paris, till Dec. 10, 1870, when they removed to Bordeaux. The Germans finally occupied Tours, Jan. 19, 1871.

**TOURVILLE, Anne Hilarion de Cotentin**, count de, a French admiral, born Nov. 24, 1642, died in Paris, May 28, 1701. After brilliant exploits against the pirates of N. Africa, which won for him from Venice the title of protector of commerce, Louis XIV. appointed him in 1667 naval commander. In 1676 he decided the victory of Agosta, and in 1677, off Palermo, he nearly destroyed the allied squadrons of Spain and Holland. After various other achievements he became in 1689 vice admiral of the Levant. In 1690, operating against the English and Dutch off Beachy Head, he pursued the former to the mouth of the Thames, where he destroyed many of their ships and transports. In 1691, as commander of the ocean fleet, he enabled the French troops to reach Ireland in aid of James II. In 1692, by positive order from Louis XIV., at the head of 44 ships, he engaged off the fort of La Hogue, on the E. coast of Cotentin, the English admiral Russell, whose forces were nearly double, and, after 12 hours of determined resistance, was defeated, but escaped to port with the remains of his fleet. In 1693 he was appointed marshal, and in the same year he captured 27 Dutch and English ships off Cape St. Vincent and destroyed 59. He retired after the peace of Ryswick in 1697.

**TOUSSAINT, François Dominique**, surnamed L'OUVERTURE, a Haytian general, born near Cap François in 1743, died in the dungeon of Joux, France, April 27, 1803. His parents were both slaves, and of pure negro blood. He was a coachman, and afterward held a post of trust in connection with the sugar manufactory of the estate to which he belonged. He had learned to read and write from a fellow slave, and after his promotion he read considerably. He remained apparently contented with his lot till 1791, when the mulattoes appealed to the negroes for help in enforcing their rights; and even then, though many of the blacks rose in insurrection, Toussaint incurred the hostility of his race by remaining quiet. But after securing the escape of the director of the estate and his family, he joined the negro army. Toussaint, at first employed in a medical capacity, was soon appointed a brigadier general. When news came of the beheading of Louis XVI. the black leaders accepted the aid of Spain, and repelled the offers of the French convention. Toussaint soon captured the entire army of Brandicourt, the general of the whites, without bloodshed, and occupied several important military posts, among them Gonaives. The English, having in 1793 invaded the island, took Port-au-Prince, while the French, the Spaniards, the mulattoes, and the blacks were all contending with each other. At this juncture Toussaint, who was already in effect the commander-in-chief of the black forces, became convinced that the only hope for Hayti lay in declaring for France, whose national legislature, while making Hayti an integral part of France, had proclaimed also the freedom of the slaves. He therefore declared his fealty to the repub-

lic, and applied himself so energetically to bring all parties to the same conclusion that Laveaux, the French commander, exclaimed: *Mais cet homme fait ouverture partout;* and from this time he received his surname of "L'Ouverture" (the opening). He formed a junction with Laveaux, and, though the Spanish and English forces united against him, he drove the English from nearly all their strong positions, took 28 Spanish batteries in four days, maintained a long line of defences against the allied enemy, who possessed twice his force, rescued Laveaux, and finally closed the campaign by receiving the capitulation of the entire English force besieged at St. Marc (1797), and the abandonment of the effort by the Spanish to conquer the W. portion of the island. Toussaint, who had been appointed commander-in-chief of St. Domingo in 1796 by Sonthonax, the French commissioner, soon restored order and industry to the island, though opposed to Hédouville, the new commissioner. Hédouville, finding himself without influence, fled to France to make complaint of the negro chieftain, who sent to the directory a statement of the true position of affairs. The French directory justified Toussaint and censured Hédouville. But the latter, on the eve of leaving Hayti, had sown the seeds of discord between Rigaud, the mulatto leader, and Toussaint, and, by finally setting the former free from his obligations to the latter, had prepared the foundations of a new civil war; and for nearly the whole of the year 1799 the war between the blacks and the mixed race raged fiercely. Toussaint captured Jacmel, subdued the mulatto insurrection, and on Nov. 26, 1800, assumed the government, amenable for his administration to the French directory alone; and in January, 1801, the whole island became subject to his sway. He invited the steward of his old master's estate and other well disposed white colonists back to the island. He assumed great state in his public appearance, being richly attired and surrounded by a guard of 1,500 to 1,800 men, all in brilliant uniforms and admirably mounted; but in private life he was plain and temperate. At the very beginning of his administration Toussaint selected an administrative council of nine, of whom eight were white proprietors and one a mulatto. A constitution was drawn up by the council, in which he was named president for life, and free trade was established. This constitution he sent with a letter to Bonaparte, then first consul, whose reply was: "He is a revolted slave whom we must punish; the honor of France is outraged." An act was passed restoring the French colonies to their condition previous to 1789. In a subsequent decree by Bonaparte St. Domingo or Hayti was excepted—an exception, as the event proved, intended to be only temporary. Gen. Leclerc, the husband of Pauline, Bonaparte's sister, was sent out with a force of 30,000 men and 66 war vessels. The expedition arrived on the coast of Hayti in January, 1802. Among those in command in it were Rigaud, Pétion, and Boyer, all enemies of Toussaint. Without a declaration of war Leclerc attempted to enter Cap François with his force, and Christophe, who was in command there, rather than surrender, burned the city. Finding unexpected resistance at all points, Leclerc sent Toussaint's sons, who had been educated in France, and whom he had brought with him, to their father, with a letter from Bonaparte and another from himself, couched in terms of mingled flattery and menace. The negotiation was ineffectual. Leclerc then declared Toussaint and his generals outlaws, and a sanguinary conflict ensued, in which one third of the French troops were killed or wounded; and though they possessed the seaports, yet the blacks from their mountain fastnesses were destroying them in detail. Finding it impossible to conquer the island in this way, Leclerc sought to win over the negro generals, and succeeded with Christophe and those under him, including Dessalines. He next made his propositions to Toussaint, offering as conditions of peace to respect the liberty of the people, and confirming this by the most solemn oaths to leave the government of the island in Toussaint's hands, and to employ the officers of his army according to their rank, while for himself he would only hold the office of delegate from France by Toussaint's side. Toussaint accepted his offers, and a treaty of peace was concluded May 1. He avowed however his own determination to leave public life, and retired to his estate near Ennery. But Leclerc had determined upon his destruction. At his direction Gen. Brunet on June 7 sent him an apparently cordial letter, asking for an interview of an hour in relation to some arrangements for providing for the black troops, inviting him to bring his wife with him, and closing with assuring him of the sincerity of his friendship. Toussaint went to Gonaives, and after a short conversation Brunet left the room, when an armed force entered and seized Toussaint, and at midnight put him on board a French frigate, with his family. On their arrival at Brest he was separated from his family, whom he was never allowed to see again. On Aug. 17 he reached Paris under guard, and was at once confined in the Temple, whence he was transferred, without trial and without any explanation of the cause of his arrest, to the dungeons of the castle of Joux, in the department of Doubs. Here, deprived of all society, subjected to the intense cold with insufficient clothing, and with too little food to sustain life, he appealed repeatedly but in vain for a trial; and as well as his failing strength would allow, he began his defence, which was transmitted to Bonaparte, but elicited no reply. Finally the governor of the castle went away for four days and left Toussaint without food or drink. On his return he was dead, and the rats had gnawed his feet. An autopsy was

held, and his death was said to have been caused by apoplexy.—Lives of Toussaint have been written, among others, by Saint-Rémy (Paris, 1850), the Rev. John R. Beard, D. D. (London, 1853), Hannah Lee (Boston, 1854), C. W. Elliott (New York, 1855), and J. Redpath (Boston, 1863).

**TOWHEE.** See CHEWINK.

**TOWN** (Ang. Sax. *tun*, from *tynan*, to enclose), originally an enclosure of the farm and farm house by a hedge, and finally of a collection of houses. Towns began to exist as municipalities in Germany in the time of the emperor Henry the Fowler (919-936), who caused all the important villages to be surrounded with walls or earthworks and ditches, as a defence against the Huns. Certain of the landless freemen were compelled to reside in these towns, while others were attracted by the privileges he conferred. These were in the nature of charters or contracts with the inhabitants, and had reference to various subjects. The germ of the town thus planted grew vigorously. The princes and bishops of the empire created towns on their own fiefs and benefices, and granted charters. For several hundred years thereafter municipal charters were granted in Europe at the political, military, or financial convenience of the ruling powers. In Spain the Christian kings created towns and granted municipal charters on the frontier, as the territory was slowly reconquered from the Moors. In England charters were granted liberally by King John, to enlist the common people on his side in his contests with the barons; and in France by Louis the Fat for similar reasons. Sometimes municipalities were chartered as a means of increasing or more conveniently collecting the king's revenue. In Holland the municipal system embraced nearly all the territory and population. In Germany leagues of the free towns were formed, either for common defence or for commercial purposes. Of the former, the Swabian league and the league of the Rhine were the most important; while of the latter, the league of the Hanse towns, or the Hanseatic league, was the most remarkable and most powerful confederation of municipalities that ever existed. (See HANSEATIC LEAGUE.) From various causes the self-governing feature of the towns of continental Europe has been almost entirely obliterated.—The system of town government has existed in New England since the settlement of the colonies, and in substantially the same form as at present, except that classes of town officers have been largely increased in number, and their various duties more particularly prescribed. Here it still prevails in its purest form; in New York and a few other states it exists in a modified form; with two or three exceptions, it is not found in the southern states. In New England it is the most important political division of the state. Excepting unorganized portions of Maine, New Hampshire, and Vermont, and certain incorporated cities which have superseded towns, the entire territory and population are under town government. In 1870 there were in New England 1,424 towns, with an average area of 34 sq. m., and an average population of 2,450, or, excluding cities and towns having over 10,000 inhabitants, 1,700. The town is a political and corporate body created by the legislature. Its rights, duties, and liabilities are defined by law, and it is responsible for any act or omission in violation of the law to the person injured or to the state. It can be fined in the same manner as an individual. Except in Massachusetts and Maine, where representation is by districts, it is entitled to an independent representation in the lower branch of the legislature. It elects its own executive officers, supports schools, maintains roads and bridges, supports paupers, restrains lunatics, manages a local police, protects the public health against infectious diseases, collects through its own officers not only its self-imposed taxes for local purposes, but also the state taxes and those levied by county officers, and generally administers its own public affairs. The town officers are usually elected annually and in the spring. The chief ones are a town clerk, three, five, seven, or nine selectmen, three or more assessors with sometimes assistant assessors, three or more overseers of the poor, a treasurer, one or more surveyors of highways, three or more members of school committee, and constables, who are required to collect taxes unless collectors are chosen. The most important officers are the selectmen, who transact the general public business of the town. Usually one of them, called the first selectman, appointed by the body from their own number or elected to that position by the freemen of the town, acts as the agent and general executive officer, but in the more important matters he consults the other selectmen. The most important business, such as that relating to taxes, and establishing roads, bridges, &c., is transacted by the voters of the town in town meeting, which is the general legislative body of the town. The county in New England is an unimportant subdivision of the state, and exists mainly for judicial purposes. Even the state does comparatively little public business, and the towns raise by taxation and expend at least eight times the amount of money that the state requires for its purposes.—In marked contrast to the town system as it exists in New England is the county system, which prevails in California, Delaware, Nebraska, Nevada, and Oregon, and in all the southern states excepting North Carolina, Virginia, and West Virginia. In these states the county is the important political subdivision of the state, while the town or township, where it exists, is little more than a nominal territorial division, without political power. The county is created by the legislature, and is responsible to the state for its share of the state taxation. Excluding

the unorganized parts of the state, the average area of the counties in these states in 1870 was 1,040 sq. m., and their average population 11,236; or excluding also the partly organized and settled states of the Pacific slope, their average area was 734 sq. m., and their average population 11,515, or about 15 inhabitants to the square mile. The affairs of the county are administered by its own officers chosen by the people of the county or appointed by other county officers. These are usually the court of county commissioners, assessor, treasurer, collector, superintendent of education, apportioners of roads, and superintendents of roads, besides certain judicial officers.—In the middle, western, and northwestern states, excepting those above mentioned, and in North Carolina, Virginia, and West Virginia, a union of the town and county systems, which has been called the "compromise system," prevails. In these states the political power, which in New England is vested in the town and in the southern states in the county, is divided between the two. The county is the political unit; it is a body politic with the usual corporate powers; but it is subdivided into towns or townships, which possess considerable political rights. Besides the county officers, there are town officers usually elected annually by the people of the town. They are clothed with minor political powers, but their action in more important matters is subject to revision by the higher county officers. In New York the powers of the county are exercised by a board of supervisors in which the towns of the county are represented as equal political communities. The supervisor who represents the town in the county board has other town duties, and is thus both an officer of the town and of the county. This is also the case in Illinois, Michigan, New Jersey, Virginia, West Virginia, and Wisconsin. In Indiana, Iowa, Kansas, Minnesota, North Carolina, Ohio, and Pennsylvania, the affairs of the county are usually managed by a board of three commissioners, who are elected from the body of the county and have no town duties whatever. In New York and the more eastern of the states where the mixed system prevails, the town in political importance approaches more nearly to that of New England; but in some parts of the west the township (this word being there more common than town) is a mere geographical division embracing 36 sq. m., and has very limited political functions. Town is often used popularly in the west to denote a small municipality, as a village. In none of the states outside of New England do the towns, or townships, as such, send representatives to the legislature. — Other forms of municipalities have been created by the different states. Boroughs and villages are corporations with peculiar powers and privileges, such as have reference to special objects and are not granted to towns by general laws. In England there are municipal and parliamentary boroughs, the former being a town (some, as Liverpool, of the largest size) having a municipal government, and the latter a town or district (sometimes including several municipal boroughs) that sends a member or members to parliament; while in the United States a borough is a municipal corporation that is usually expected to become a city at some future time, having powers less extensive than those of a city and different from those of a town. In the extent and variety of its powers the city is the most important municipality. In England a city is any town that either is or has been the see of a bishop and has a cathedral; but in the United States the distinction between a town and a city usually refers to size and always to the form of municipal government. The governing power of cities is usually vested in a mayor and council, composed of one or two boards; but the details of the government vary greatly. Probably no two cities can be found whose charters or governments are precisely alike.—See Elliott's "New England History" (Boston, 1857); Haines's "Township Organization" (Chicago, 1865); "The Origin, Organization, and Influence of the Towns of New England," by Joel Parker (Cambridge, 1867); and the article on "The Minor Political Divisions of the United States," by S. A. Galpin, in the "Statistical Atlas of the United States" (1874). Town manuals have also been published in New York and most of the New England states.

**TOWNLEY, Charles**, an English collector of works of ancient art, born in Lancashire, Oct. 1, 1737, died in Westminster, Jan. 3, 1805. He received his education on the continent, and during a residence in Rome between 1765 and 1772 he devoted his fortune largely to the purchase of ancient marbles, terra cottas, bronzes, gems, &c., aided by the advice and experience of Winckelmann and others. After his return to England, he added to his collection by means of agents at Rome, and by purchasing that of Nollekens. After his death his collection of marbles was purchased by the nation for £20,000, and in 1814 his bronzes, coins, and gems became the public property at a cost of £8,200. All are now incorporated with the general collection of Græco-Roman remains in the British museum.

**TOWNS**, a N. E. county of Georgia, bordering on North Carolina, and drained by the head streams of the Hiawassee river; area, about 250 sq. m.; pop. in 1870, 2,780, of whom 155 were colored. The surface is hilly and mountainous, and the soil generally fertile. The chief productions in 1870 were 5,090 bushels of wheat, 5,389 of rye, 61,990 of Indian corn, and 8,927 of oats. There were 458 horses, 1,975 cattle, 2,575 sheep, and 4,183 swine. Capital, Hiawassee.

**TOWNSHEND. I. Charles**, second viscount, an English statesman, born in 1676, died at Rainham, Norfolk, June 21, 1738. He succeeded to his title at ten years of age, and soon after

taking his seat in the house of peers attached himself to the whigs. In 1706 he was appointed one of the commissioners to treat for the union with Scotland, and in 1707 captain of the yeomen of the queen's guard; and in 1709, in the capacity of ambassador extraordinary to the United Provinces, he negotiated the barrier treaty. The accession of George I. having brought the whigs into power, Townshend was appointed one of the principal secretaries of state, and took the lead in the administration until the summer of 1716, when, owing to the intrigues of his colleagues, Lord Sunderland and Gen. Stanhope, he was dismissed. To break the ignominy of his fall, he was offered the lord-lieutenancy of Ireland, which he indignantly declined; but the king, fearing the public displeasure, induced him to accept it. The growing influence of Sunderland and Stanhope with the king rendered the position uncomfortable, and, with his colleague and brother-in-law Walpole, he retired from office in April, 1717. After remaining several years in opposition, he was in 1720 appointed president of the council, and on the reconstruction of the ministry in 1721 he resumed his old position of secretary of state, Walpole becoming first lord of the treasury and chancellor of the exchequer. Finally, displeased with Walpole's growing ascendancy and disputing upon questions of public policy, Townshend resigned, May 15, 1730. **II. Charles,** an English statesman, grandson of the preceding, born Aug. 28, 1725, died Sept. 4, 1767. He entered parliament in 1747, and in 1753 brought himself into notice by a speech of great power and eloquence on the marriage bill. In 1754 he was appointed a lord of the admiralty, and in the first administration of Pitt he was treasurer of the chamber, which office in 1761 he exchanged for that of secretary of war. During the ministry of the earl of Bute he remained out of office, but in that of George Grenville which succeeded (1763), he was appointed first lord of trade and the plantations. He zealously supported Grenville's stamp act, introduced in 1765, in a speech which elicited from Col. Barré in reply one of the most memorable efforts of parliamentary eloquence; but during the Rockingham administration, in which he held the office of paymaster of the forces, he advocated the repeal of the act. On the formation of the second Pitt administration in 1766, he became chancellor of the exchequer, and, with a vacillation which gained him the name of the weathercock, advocated the necessity of a tax upon American ports. On June 2, 1767, he introduced into the house of commons the celebrated resolutions imposing duties upon paper, tea, and other articles imported into the American colonies, which eventually led to their revolt and independence. The illness of Pitt rendered necessary a reconstruction of the cabinet, and Townshend was generally understood to have been selected to form a new ministry, when he suddenly died.

**TOWNSHIP.** See Town, and Surveying.

**TOXICODENDRON.** See Sumach.

**TOXICOLOGY.** See Poison.

**TOXODON** (Gr. τόξον, a bow, and ὀδούς, a tooth), a name applied by Owen to a genus of extinct mammals of the order of ungulates, with affinities to edentates and rodents. The first species, named by Owen the *T. Platensis*, was found in a miocene clay in South America, about 120 m. N. W. of Montevideo; it was established on a cranium 2½ ft. long, elongated, with a flattened occiput, small cerebral cavity, remarkably strong and widely expanded zygomatic arches, and transverse glenoid cavity; the upper molars were seven on each side, implanted with the convexity outward, the opposite of what occurs in rodents; they were long, arched, without roots, the enamel forming an irregular prismatic grooved tube; upper incisors four, the external the largest, like those of rodents in structure, and worn away in the same chisel shape; in the lower jaw were seven molars on a side, and six incisors ranged in a semicircle; the name was derived from the curve of the outer upper incisors. It was large, low on the legs, with the aspect and habits of a pachyderm. It shows an affinity to the *sirenia* (like the manatee) in the flattened occiput, small brain cavity, and nasal passages widely opened above, but differs in the size of the frontal sinuses and in the incisors; it seems to have formed a connecting link between the rodents and the ungulates. It was probably aquatic to a certain extent.—See "Fossil Mammals of the Voyage of the Beagle," described and figured by Prof. Owen (4to, London, 1840).

**TRACHEOTOMY** (Gr. τραχεῖα, the windpipe, and τέμνειν, to cut), a surgical operation by which the trachea or windpipe is opened. Tracheotomy may be performed with propriety in cases where admission of air into the lungs is obstructed either by disease or by a foreign body; and it has sometimes been tried with success to facilitate the inflation of the lungs in cases of suspended animation. The operation is not free from danger, and in the first class of cases, though giving marked temporary relief, it does nothing toward curing the disease itself. It consists in first making an incision in the median line of the throat, either below or above the thyroid gland, and dissecting down to the trachea, cautiously pushing aside the sterno-hyoid muscles and vessels lying in the vicinity, till the trachea is exposed. When the bleeding has ceased, the trachea is opened by a vertical incision, and a portion of one or more of its rings removed; through the opening thus made a silver canula is introduced, which when obstructed by mucus may be removed, cleansed, and again inserted. If the obstruction to respiration is removed, the canula may be withdrawn and the orifice allowed to heal; but if not, the canula must continue to be worn. If the operation is performed to aid in restoring animation or to remove a foreign body, no canula need be inserted, and

the wound should be closed so soon as the object is effected.

**TRACHYTE** (Gr. τραχύς, rough), a rock of volcanic origin, named from the roughness of its surface. It consists chiefly of glassy feldspar, sometimes associated with hornblende, and also with augite. When these minerals predominate, the rock passes into the varieties of trap called basalt, greenstone, dolerite, &c.

**TRACT AND PUBLICATION SOCIETIES.** The printing of short religious treatises and narratives for cheap or gratuitous distribution was very early practised. Indeed, prior to the introduction of printing, Wycliffe circulated his views by means of brief essays, which were transcribed and passed from hand to hand. Strype testifies to the circulation of some of Tyndale's tracts about 1530. In the 17th century there were associations for printing and promoting the sale of religious works. In 1701 the "Society for Promoting Christian Knowledge," consisting of members of the church of England, was founded to promote charity schools in all parts of England and Wales, and to disperse both at home and abroad Bibles and tracts of religion. In 1742 John Wesley began the publication and distribution of tracts and books on a large scale, and in 1782 he and Dr. Coke organized the "Society for the Distribution of Tracts among the Poor." In 1750 the "Society for Promoting Religious Knowledge among the Poor" was organized in London, and was the first publishing society in which members of different religious denominations were united. In 1756 societies were established at Edinburgh and Glasgow for similar objects, and for several years circulated many religious publications; but eventually they as well as the London society declined. In 1795 Miss Hannah More commenced at Bath a monthly series of short religious tales which she named "Cheap Repository," of which 2,000,000 copies were sold the first year. In it was published the widely popular story of "The Shepherd of Salisbury Plain." Mrs. Rebecca Wilkinson, of Clapham, Surrey, also wrote and published many small books and tracts. The "Philanthropic Society" printed for her in the course of a few years, commencing with 1792, 440,250 copies of books and tracts.—In 1793 the "Religious Tract Society," or as it is now called the "Religious Tract and Book Society of Scotland," was founded in Edinburgh by the Rev. John Campbell, a missionary to Africa. In 1855 this society adopted the colportage system of the American tract society, to which it has since given a large part of its effort. In that year it sent out three colporteurs; in 1875 it sent out 234 in Scotland and 20 in the north of England. In the year ending March 31, 1875, its circulation was 2,855,000, including 55,000 copies of the Scriptures and 120,000 other bound volumes, besides 300,000 hymn books, 1,240,000 periodicals, and 1,140,000 tracts.—The "Religious Tract Society" of London was founded in May, 1799. It had its origin in the labors of the Rev. George Burder of Coventry, who had begun printing tracts on his own account in 1781, of a more directly religious character than those of Miss More. He continued their occasional issue in connection with some friends for several years, and then convened a meeting of ministers by whom the society was established under its present name. Among them were the Rev. Messrs. Rowland Hill, William Newman, Matthew Wilks, and Joseph Hughes, for many years its secretary. Its entire receipts the first year were £467 7*s.* 4*d.*, of which £203 10*s.* 8*d.* were from contributions, &c., and £263 16*s.* 8*d.* from sales. In 1849, when the society celebrated its jubilee, they had risen to £50,981 15*s.* 8*d.*, of which £4,939 2*s.* 8*d.* were from contributions, &c., and £44,603 16*s.* 6*d.* from sales. The total receipts of 50 years from contributions and legacies, up to 1849, were £152,552 3*s.*, from sales £1,023,215 13*s.* 1*d.*, making with other items £1,202,242 13*s.* 8*d.* By the expenditure of this sum the society had published 5,148 different works in 110 languages and dialects, of which it had issued over 500,000,000 copies. It now keeps on its catalogue about 10,000 different publications. It issued during the year ending March 31, 1875, 303 new volumes and 167 new tracts. The total circulation from the home depositories during the year was 46,536,057, including about 23,000,000 tracts. The issues in foreign depositories in Europe, India, China, Africa, and elsewhere were about 10,000,000 more. The entire number of issues since the formation of the society was about 1,595,000,000, of 13,023 different publications in 120 different languages and dialects. Its grants of books, tracts, &c., for the year amounted to £28,328 7*s.* 7*d.* This society owns no presses or bindery. It maintains three depositories in London, one at Brighton, one at Manchester, and others in the principal cities of continental Europe, in Constantinople, Beyrout, and different cities of India, China, and Japan; and there are auxiliary and coöperating societies in Great Britain, Canada, and Australia. During the year it made grants of books and tracts to the colporteurs in the north of England from the religious tract and book society of Scotland, and a grant amounting to £400 to the negroes of the southern United States. There are several other societies in Great Britain for the circulation and distribution of religious books and tracts, each of the principal religious denominations having one or more.—The most important of the tract societies of continental Europe is the Hamburg tract society, organized in 1836, which issued from April 1, 1872, to Nov. 1, 1874, 2,648,000 copies of its publications in German, Danish, and Lettish; and it has issued since its organization 27,000,000 tracts in seven languages. The Paris tract society has issued 665,380 publications. The Toulouse book society has issued 137,129 vol-

umes. The evangelical society of Geneva, organized in 1831, expended in 1874 $15,000, and has issued in all 335,000 volumes and 3,000,000 tracts. The Belgian evangelical society issued 1,380 volumes and 202,000 tracts in 1874. The British American book and tract society was organized at Halifax in 1867, and has given its effort largely to colportage. In 1874 it employed 26 colporteurs at an expense of $34,629. Its total expenditure has been $169,193.—The first religious publication society in the United States was the "Methodist Book Concern," originally established in Philadelphia, which issued its first publication in 1789. It was removed to New York in 1804, and for 29 years had its depository in Crosby street. In 1822 the agents established a bindery, and in 1824 added a printing office. In 1833 it was removed to No. 200 Mulberry street, and in February, 1836, its premises were destroyed by fire, and a loss of $250,000 incurred. A new building was immediately erected on the same site, which is still occupied by the printing office and bindery. In 1869 a building for a sales house and offices was purchased in Broadway at the corner of 11th street. The book concern has a depository in Cincinnati, which publishes periodicals and a few books; it has also depositories publishing denominational journals, and keeping full supplies of its books, at Boston, Pittsburgh, Chicago, St. Louis, and San Francisco; and the ministers of the denomination are agents for the sale and circulation of its journals and tracts. Its publications consist of books, periodicals, and tracts. The book concern is conducted strictly as a business house, and makes no donations. In 1874 the Methodist Episcopal tract society made donations of tracts, purchased from the book concern, to the value of $15,000, besides contributing more than $5,000 for the publications of missionary presses in foreign lands. In 1844 the division of the Methodist church led to the organization of a book concern connected with the Methodist church, South, at Nashville, Tenn., which eventually received $200,000 of the capital of the book concern as the share of the church south. —The Rev. Dr. John Stanford published tracts in New York in 1786. In 1803 the Massachusetts "Society for Promoting Christian Knowledge" was formed by the Rev. Drs. Tappan, Holmes, and Morse, Lieutenant Governor Philips, and others. This seems to have been the earliest undenominational tract society organized in America. Subsequently numerous local societies sprung into existence, of which the "Religious Tract Society" of New York, founded in 1812, and the "New England Tract Society" at Andover, in 1814, seem to have been the most efficient. The latter grew rapidly, and in 1823 changed its name to the "American Tract Society," and shortly thereafter its location to Boston, greatly enlarging its operations. In 1825 this society had 205 auxiliaries, had issued 177 general tracts and 19 of a series for the young, had published in all over 800,000 copies, and had commenced the publication of an almanac and a monthly journal. In the spring of 1825 the "American Tract Society" was organized in New York, and was intended to unite the local societies then in existence as far as possible as auxiliaries. The Boston society became a branch of it. This union continued till May, 1859, when, in consequence of the dissatisfaction of a considerable number of the members in New England and elsewhere at the hesitation of the American tract society in New York to publish tracts or treatises on the subject of slavery, the two societies resumed their independent organizations. In 1870 the total sales of the society at Boston amounted to $103,027 38, and the expenses of the charitable department to $7,970 95. In 1871 it simplified its plan of operation by contracting with a publishing house to print, bind, and sell its tracts, periodicals, and books. This arrangement proved efficient and economical, and enabled the society, while carrying forward its usual work, to clear off, before May, 1875, a debt of $22,493 27 incurred previous to 1871. This plan is still pursued. The American tract society in New York, owning a large building in Nassau and Spruce streets called the "Tract House," manufactures its publications, and has become one of the largest of the national benevolent societies of the country. At first only English tracts were printed, 215 the first year; the third year one volume, and tracts in Spanish, French, and German. Every succeeding year the list was enlarged, until at the end of 50 years (1875) its catalogue contained 1,133 volumes and 3,497 smaller publications. In 1843 was commenced the "American Messenger," a monthly family paper; in 1847 the *Botschafter*, a German paper; in 1852 the "Child's Paper," an illustrated juvenile; in 1871 the "Morning Light," an illustrated monthly for beginners, the "Illustrated Christian Weekly," and the *Volksfreund*, a similar weekly in German. The average daily issue from the tract house is 54,000 copies of publications, of which 4,000 are volumes; and the entire issue from the beginning has been 358,718,338 copies, of 8,338,141,531 pages, of which 331,683,312 copies were tracts averaging about 8 pages each, and 27,035,026 volumes, averaging about 208 pages; 36,307,806 tracts and 2,603,884 volumes were in foreign languages. The society has also expended in printing at mission stations in foreign lands $616,637 30. The entire receipts from April, 1825, to April, 1875, were $13,597,589 63, of which $8,957,219 50 were from sales, $312,274 69 from rents, and $4,328,095 44 from donations and legacies. In 1842 the society commenced its colportage system, which it has maintained up to the present time. The *colporteur*, as the term is employed by the society, is an itinerant missionary, who distributes its publica-

tions either by sale, partial sale, or gift, as may seem best in each case, from the desire to do good, and also engages as opportunity offers in the more direct missionary labors of preaching, prayer, and religious conversation; his expenses are partly defrayed by the society, and partly by the sales of books. Through this agency, for the 34 years from its establishment in 1842 to 1875, 10,503,696 volumes were sold and 2,780,066 given away.—The different religious denominations have each also their tract or publication societies, of which the most important particulars are given in the following table:

| ORGANIZATIONS. | Date of Organization. | No. of publications on catalogue. | ISSUED DURING THE YEAR 1874–'5. | | Value of issue during 1874–'5. |
|---|---|---|---|---|---|
| | | | Volumes. | Tracts, pamphlets, and periodicals. | |
| Methodist Episcopal book concern | 1789 | 2,809 | 352,170 | 35,055,428 | $1,580,613 74 |
| Baptist publication society | 1824 | 1,156 | 180,900 | 9,678,482 | 262,597 14 |
| Presbyterian board of publication | 1833 | .... | 689,000 | 4,917,878 | 307,728 02 |
| Protestant Episcopal evangelical knowledge society | 1847 | 382 | ........ | 480,000 | .......... |
| " " church book society | 1854 | 650 | ........ | ........ | .......... |
| Reformed church board of publication | 1854 | 100 | 6,200 | 200,600 | 12,302 27 |
| New Church (Swedenborgian) tract and publication society | 1863 | 1,000 | 7,957 | 25,235 | .......... |
| Congregational publishing society | 1829 | 1,000 | 140,000 | 1,820,000 | 139,538 99 |

**TRACTARIANISM,** a movement within the church of England, so called from a series of papers entitled "Tracts for the Times," published at Oxford from 1833 to 1841. It may be traced to the agitation of Roman Catholic emancipation in parliament, and particularly to the suppression of the sees of the Irish bishops who voted against the reform bill in the house of lords in 1831. An address deprecating change, and urging a revival of the ancient discipline, was presented to the archbishop of Canterbury, signed by 7,000 clergymen; in the following May the king alluded to the movement in his birthday speech; and meetings were held throughout the country in behalf of the maintenance of the church. The sentiments now advocated had been already expressed by the Rev. John Keble in his "Christian Year" (1827), and by the Rev. Hugh James Rose in the "British Magazine." In July, 1833, a conference was held at Hadleigh, which led to the publication of the "Tracts for the Times." These were 90 in number, and consisted of extracts from the writings of the ante-Nicene fathers and some later ecclesiastical authorities, and original works by E. B. Pusey, John Keble, Isaac Williams, John Henry Newman, and others. They advocated the doctrines of apostolical succession, baptismal regeneration, the real presence, priestly absolution, the authority of the church, and the value of tradition. The movement culminated in the publication of tract No. 90, which maintained the compatibility of the thirty-nine articles with the doctrines of the Roman Catholic church. This was condemned by the hebdomadal board of Oxford university in 1841, and its author, Dr. Newman, in 1843 resigned his vicarage of St. Mary's, Oxford, and in 1845 entered the Roman Catholic church. In 1843 Dr. Pusey was suspended from the office of university preacher on account of a sermon on the eucharist. The tractarian movement has resulted in the development of high church and ritualistic views, the restoration and building of numerous churches, and the secession of many members of the church of England, including some clergymen of distinction, to the Roman Catholic church.—See Perceval, "Collection of Papers" (1842); W. Palmer, "Narrative of Events" (1843); and F. Oakeley, "Historical Notes on the Tractarian Movement" (1865).

**TRACTORS, Metallic.** See Perkins, Elisha.

**TRACY.** See Destutt de Tracy.

**TRADE MARK,** the name, symbol, form, or device used by a manufacturer or merchant to distinguish the merchandise which he produces or sells from that of others, in order that such merchandise may be known as his, and that he may secure the profits arising from its reputation for superiority. Trade marks have long been protected by law, on the general principles of equity, in nearly all civilized countries; but statutes for this purpose are of recent origin. The object of such laws is not only to secure to the individual the fruits of his skill, industry, and enterprise, but also to protect the public against frauds. In the United States trade marks are protected by the statute of 1870, which is the first one passed by congress for this purpose. It does not interfere with the common law protection, which is open to every person independently of the statute. It provides that any person or firm domiciled in the United States, or any corporation created by the law of the United States or of any state, may, by complying with the requirements of the act, obtain protection for any lawful trade mark to which he or it is entitled, for the term of 30 years, with the privilege of a renewed term for the same period. Every applicant must record in the patent office his name, residence, and place of business; the class of merchandise, and the particular description of goods comprised in such class, to which the trade mark has been or is intended to be applied; a description of the mark, with facsimiles thereof and its mode of use; and the length of time, if any, during which it has been used.

He must also pay a fee of $25, and file a sworn declaration that he is entitled to the exclusive use of the mark, and that the description and facsimiles presented are true representations. If, on examination in the patent office, such symbol is found to have the requisites of a valid trade mark, it is registered, and the owner becomes entitled to legal and equitable remedies against its violation.—Property in a trade mark is acquired by the original application to some species of merchandise of a device or symbol not in actual use to designate articles of the same kind or class. If such symbol have the essential qualities of a lawful trade mark, the owner becomes entitled to its exclusive use within the limits prescribed by law. But whoever first adopts a mark acquires a right to its exclusive use only in connection with the particular class of merchandise to which he has applied it. His right to use it as a mark on iron does not prevent its lawful use by another on cloth. The mark must also be put into actual use before it may be claimed exclusively by any person; protection begins from the time of such use, without regard to whether the mark has gained a reputation. No person will be protected in the use of a trade mark which is not truthful, and is used with the design of deceiving the public, or which is employed in any unlawful business, or upon any injurious article.—One of the most important requisites of a valid trade mark is that it shall, either by itself or by association, point distinctively to the origin or ownership of the article to which it is applied. By its individuality, it must associate the merchandise with the producer or the place of production, so that the purchaser may know that all articles bearing the same mark are genuine and of the same quality and from the same source. The mark thus becomes equivalent to the owner's commercial signature.—No person has a right to the exclusive use of a mark which is of such a character that others may employ it with equal truth. A generic name of an article, or one merely descriptive, or representing the kind, quality, ingredients, or characteristics of the article, may not be used as a valid trade mark. "Parchment deed," "beeswax oil," "superior white wheat," "desiccated codfish," are not valid as trade marks, because they are the proper descriptive appellations of the articles. Geographical names used in their proper sense cannot become lawful trade marks. All coal mined in the Lackawanna valley, or all wheat grown in California, may be sold as "Lackawanna coal" or "California wheat," by whomsoever produced. But if the phrase is used as an arbitrary symbol, and is not intended to represent that the merchandise is produced in the region bearing the name, and is so understood by the public, it may be monopolized as a mark for any class of goods. "Damascus blade," applied to scythes made in the United States, is a valid trade mark.—It is not clearly settled how far a person's own name will constitute a valid trade mark independently of the statute. In general all persons of the same name have an equal right to any honest use of such name. But if one person has acquired a valuable reputation for his own name in connection with a particular kind of merchandise, a court of equity might restrain another person of the same name from using it as a trade mark for the same class of goods, if his intent were clearly to deceive the public and to injure the person who had first so employed it. The statute of 1870 prohibits the registration of any proposed trade mark "which is merely the name of a person, firm, or corporation only, unless accompanied by a mark sufficient to distinguish it from the same name when used by other persons;" except that any lawful trade mark in use when the act was passed may be registered. Names of persons, living or dead, other than the owner of the trade mark, may be monopolized as arbitrary. Symbols for any class of goods, as "Bismarck collar," pseudonymes or imaginary names, &c., will also be protected. Mere initials or numerals do not generally constitute valid trade marks, but may become so in special cases. The title of a book, newspaper, magazine, or other publication may have the essential characteristics of a trade mark; but in such cases protection has usually been granted on the ground of fraud committed by the person who has unlawfully appropriated such title, or one closely resembling it.—Property in a trade mark is invaded when a person falsely uses such mark or a colorable imitation of it, with the intention or effect of falsely representing his own goods as those of another. The usual remedy of the injured person is by an injunction restraining the wrong doer from a further use of the name, or by an action at law for damages. Generally an injunction will be granted by a court of equity only when the petitioner's legal title is clear. If the lawful owner have suffered damages, he may proceed in equity for the profits made by the wrong doer, or he may sue at law for the loss he has sustained. The good will of a trade is a species of property analogous to that in trade marks.—The statute of 1870 provides for extending protection to the trade marks of aliens resident in any foreign country which by treaty or convention affords similar privileges to citizens of the United States. Treaties and conventions for this purpose have been concluded with France, Belgium, Germany, the Austro-Hungarian empire, and Russia. The principal countries of Europe have passed laws for the protection of trade marks, and in some it is obligatory upon manufacturers to affix marks to their products.

**TRADES UNION**, an association of workmen for concerted action upon questions of wages, hours of labor, and other conditions of employment, and for mutual relief. Apart from the mediæval craft guilds, which included employers (see Guild), combinations of workmen to ob-

tain increased wages have occasionally appeared for several centuries; but until a comparatively recent date they were everywhere the object of severe legal penalties. Toward the close of the last century the formation of workmen's societies received a new impulse from the introduction of machinery, which, by concentrating the leading industries in large establishments, gradually reduced many small masters to the position of laborers, and vastly increased the difficulty of rising from the working to the employing class. In England unions had been formed among the wool combers, cotton spinners, weavers, calico printers, scissors grinders, and men of other trades, before the beginning of this century. New laws prohibiting such combinations were enacted in 1799 and 1800, but were evaded in various ways; and in 1824 a committee of the house of commons reported that these laws had only produced irritation, distrust, and violence. They were repealed, and an act was passed to protect combinations of workmen or employers from prosecution for conspiracy under the common law. Later acts were still more favorable to the unions, providing for their registration and enabling them to hold real estate. At the beginning of 1876 the number of members enrolled in the trades unions of the United Kingdom was estimated at 1,200,000, of which number more than one fourth is comprised in the 14 societies named in the following table:

| NAMES OF SOCIETIES. | Date of organization. | Year of report. | No. of branches. | No. of members. | Year's income. | Year's expenditures. | Funds in hand. |
|---|---|---|---|---|---|---|---|
| Amalgamated society of engineers | 1851 | 1874 | 379* | 43,150 | £118,556 | £80,490 | £238,990 |
| Friendly society of operative stone masons | 1833 | ....... | 360 | 26,000 | 28,939 | ...... | ...... |
| United operative masons of Scotland | 1852 | 1874 | 98 | 10,652 | 9,577 | 3,350 | 9,939 |
| Friendly society of iron founders of England, Ireland, and Wales | 1809 | 1874 | 106 | 12,097 | 86,467 | 29,246 | 56,543 |
| Boiler makers and iron ship builders of Great Britain and Ireland | 1834 | 1873–'4 | 143 | 14,715 | 33,945 | ..... | 49,208 |
| Amalgamated society of carpenters and joiners | 1860 | 1874 | 265† | 13,817 | 84,484 | 23,670 | 41,264 |
| Amalgamated society of tailors | 1866 | 1873–'4 | 261 | 13,293 | 13,343 | 8,506 | 7,004 |
| Amalgamated society of railway servants | 1871 | ....... | 173 | 14,500 | ...... | ...... | 9.300 |
| Amalgamated association of iron and steel workers | .... | 1874 | 269 | 21,962 | ...... | 21,382 | 15,000 |
| Durham miners' association | 1869 | ....... | 217 | 40,000 | 44,618 | 33,884 | ...... |
| West Yorkshire miners' association | 1871 | 1874 | 80 | 13,500 | 43,806 | 31,174 | 13,415 |
| Northumberland miners' mutual confident association | .... | 1873 | .... | 17,000 | ...... | ..... | 19,000 |
| National agricultural laborers' union | 1871 | 1874–'5 | 1,368 | 58,652 | 41,244 | 38,125 | 4,000 |
| Amalgamated association of operative cotton spinners | 1870 | 1873–'4 | .... | 12,812 | ...... | ...... | 30,000 |

The following societies comprised in 1875 a membership of 258,550:

| | |
|---|---|
| Miners' national union | 146,000 |
| South Yorkshire miners' association | 25,000 |
| East Lancashire power-loom weavers | 16,000 |
| Federal union of agricultural laborers | 30,000 |
| Kent and Sussex agricultural laborers' union | 10,000 |
| General union of carpenters and joiners | 9,700 |
| Operative bricklayers' accident and burial society | 7,350 |
| United Kingdom society of coach builders | 7,300 |
| North Wales quarrymen's union | 7,200 |

The 23 societies named above comprise all having not less than 7,000 members which were represented in the national trades union congress at Liverpool in January, 1875, or in that held in Glasgow in October of the same year, besides a few that were not represented in either. Their aggregate membership is 570,700, or nearly half of the total estimated membership of the trades unions of the kingdom.—Trade societies comprise those organized for trade purposes alone, such as mutual support in strikes, and those which are also mutual benefit associations, the latter class now comprising nearly all of the stronger organizations, in which the expenditures for benefits are usually much greater than those incurred for strikes. But on the other hand, the amalgamated association of miners paid £80,000 within one year (1874–'5) to assist branches on strike in South Staffordshire. By the periodical publication of reports showing the state of trade in various towns and districts, some of the unions render valuable service; and another useful device is that of keeping in each of the larger towns a "vacant book," in which the names of men out of employment and employers in want of men are registered. The qualifications for membership generally include good health, sound physique, ability as a workman, steady habits, and good moral character; and (except in societies of unskilled laborers) the candidate must have served a regular apprenticeship to his trade. The minimum limit of age for admission to full membership is usually 21 years; the maximum varies from 35 to 50 years. A prime object of these organizations is to obtain better wages, shorter time, or more agreeable conditions of employment. They discountenance long engagements at a preëstablished rate of wages, oppose the practice of working beyond the customary hours, object to working in the same establishment with non-unionists, and usually seek to establish in each town or district a minimum rate of wages. In the skilled trades they insist upon apprenticeship, and seek to regulate the proportion between apprentices and workmen, defending their action on the ground that it is the workman, and not the employer, who instructs the apprentice. In the various trades connected with building and engineering the members of the unions generally refuse to work under piece masters or sub-contractors. The objection to piece work is, that it is desired by

* Of these, 7 were in Australia, 3 in New Zealand, 6 in Canada, 31 in the United States, and 6 in other countries.

† Of these, 14, comprising 447 members, were in the United States, and 4 were in Canada.

the employers only for the purpose of exciting among the men a spirit of rivalry, which in their opinion would result in a reduction of wages or an increase in the hours of labor. In the mining trade, when the output of coal has been in excess of the demand, they have sometimes insisted on diminishing production, in order that the price might not fall so low as to entail a reduction of wages. Some unions have endeavored to fix a limit to the amount of work which each man might do.—One of the best results of free association among the workmen of the United Kingdom is the mental culture which it has promoted. The members of trades unions generally believe that wages have been considerably raised through their agency, and they usually assume that this advantage to the workmen has been gained by cutting down the profits of the employers. Some employers deny that the unions have affected wages at all, while others complain that they have affected them to an injurious degree. Among political economists, some strenuously maintain that wages can only be determined by the law of supply and demand; others admit that combination may have raised the rate of wages in particular trades, but contend that it has thereby raised the price of the products of those trades in the same proportion, and thus increased the cost of living to all classes, including large masses of workmen, who, without receiving any increase in their own wages, are compelled as purchasers of commodities to contribute to the increase received by their more fortunate fellows. On the other hand, Mr. W. T. Thornton, in his well known work on labor published in 1869, argues that the efforts of the trades unions have raised the wages of laborers in general, and estimates the addition thus made to the aggregate earnings of the working men of the United Kingdom at £9,000,000 per annum.—A trades union congress, composed of delegates from different unions and local federations, has been held annually since 1869. Thus far these congresses have confined their attention to objects which had a direct relation to the interests of the working classes, such as providing for the proper ventilation of mines, and reducing the hours of labor for women and children. Toward the adoption of such measures they have materially contributed, and the passage of the labor laws of 1875 is mainly attributable to the exertions of their committee. A federation for defensive purposes, called the United Kingdom alliance of organized trades, has existed for several years, but does not embrace any of the larger unions. There is also a workman's international league (distinct from the revolutionary international workingmen's association), having for its object concert of action between English and foreign workmen in certain trades wherein the keenness of international competition tends to depress wages. —A national federation of associated employers of labor was formed in August, 1873. The scope of its operations was limited to parliamentary legislation, the collection and distribution of information upon industrial questions, and the endeavor to secure unity of action among employers. The masters in the principal trades have long had associations for the specific purpose of resisting those of the men. In case of a strike against one of their members, they assist him in obtaining other workmen, supply him with funds or credit, undertake or guarantee his contracts, and in other ways help him to dispense with his workmen until they accept his terms. A "lockout" is a retaliatory measure on the part of employers, to deprive workmen on strike of assistance from others by throwing the latter out of employment. The occurrence of strikes and lockouts has often been attended with riotous demonstrations and destruction of life and property. The principal strikes since the repeal of the combination laws were as follows:

| TRADES. | Date. | No. of persons idle. | Duration of strike. |
|---|---|---|---|
| Manchester cotton spinners...... | 1829 | 10,000 | 6 months. |
| Ashton and Staleybridge cotton spinners.................... | 1830 | 30,000 | 10 weeks. |
| Liverpool building trades......... | 1833 | ...... | 6 months. |
| Preston cotton spinners.......... | 1836 | 8,000 | 13 weeks. |
| Amalgamated engineers.......... | 1851 | 3,000 | 8 months. |
| Preston cotton spinners.......... | 1854 | 17,000 | 36 weeks. |
| London building trades.......... | 1859 | 7,856 | ......... |
| General lockout in the iron trade. | 1865 | 200,000 | 16 weeks. |
| Clyde ship-building trade........ | 1866 | 18,000 | several months. |
| North of England iron trade..... | 1866 | 12,000 | 5 months. |
| Colliers of South Wales.......... | 1871 | 10,000 | 12 weeks. |

At the end of 1875 a strike occurred at the Erith iron works, which threatened to become general, the workmen resisting and the employers insisting upon piece work.—Members of the amalgamated society of engineers who were engaged in the unsuccessful strike of 1851 emigrated the same year to Australia, and established a branch at Sydney. Trades unions have since become general in Australia, and have enabled workmen not only to make their own terms with employers, but to exert a powerful influence upon legislation, especially in defeating appropriations to promote immigration of laborers. They have a trades and labor council comprising 23 societies and 3,000 members, with a permanent committee on parliamentary representation. In this colony eight hours as a rule constitute a working day, and wages vary from 1*s.* to 2*s.* (24 to 48 cts. gold) an hour. Trades unions also exist to some extent in New Zealand and other British colonies. There is an association known as the "Canada Labor Union," composed of delegates from the local trades unions, the object of which is to influence legislation in the interest of the working class. There are no trades unions in Canada of national (or rather of colonial) extent, except those which are connected with organizations in the United States.—Trades unions after the

English model (*Gewerkvereine*) began to appear in Germany in 1868. The laws prohibiting combination had been repealed in Prussia two years before, and a law passed permitting employers and workmen (excepting agricultural laborers) to arrange terms in their own way, provided they abstained from physical compulsion, insults, and defamation. A similar law was passed by the parliament of the North German confederation in 1869. The same year Dr. Max Hirsch formed a plan to unite the working classes of Germany into one confederation under a central direction. The local branches of all the trades within certain limits elect some central branch (if in a large town) or the branches of some central place, and commit to such branch or branches the election of a general council, which exercises the chief executive power, while the legislative power is committed to an assembly of branch delegates. These local or district federations are united in a national federation, with a legislative assembly composed of their several delegates, and a central executive committee elected by the assembly. There is also an officer known as the union attorney, who, besides being the chief business manager of the confederation, has the special task of disseminating its principles. Unlike the English trades unions, which sprang from small affiliations spontaneously formed by the working men, the system of the German *Gewerkvereine* originated with a member of the professional class, and existed in its completeness as an idea before the local unions had come into being. The number of members embraced in the German unions is therefore not as great as might be expected, in view of their elaborate organization. In 1869 it was stated at 30,000, comprised in 267 local societies existing in 145 towns, and representing the following trades: miners, masons and stone cutters, potters, carpenters, shipwrights, cabinet makers, shoe and harness makers, tailors, weavers, painters and lithographers, gold and silver smiths, machine builders, and metal workers. Besides these, the confederation included societies of factory operatives and other workpeople belonging to no special trade. By 1872 the number of trades had increased from 13 to 18, and the number of branches from 267 to 350; but the membership had fallen off to the extent of nearly 10,000, which was attributed in part to the war with France, and in part to the discouragement which followed the failure of the great strike of 1869 among the miners at Waldenburg in Silesia, which had been supported by the confederation. The increase of membership in 1873 and 1874 was about 2,000. There are large numbers of German trades unions devoted to the socialistic doctrines of Lassalle, who hold aloof from the confederation organized by Hirsch, and stigmatize its leaders as "harmony apostles." The growth of trades unions among the socialist workmen is greatly checked by the action of the police, who break up large numbers of such societies every year, for interference in politics.—In France the legal position of the working class with respect to the right of combination is but indistinctly defined. In 1864 the law upon this subject was so modified as to make coalition no longer a crime, and to give to workmen the right of striking as well as that of holding public meetings. But the law of 1791, which prohibits societies composed of persons of the same trade or profession, was still in force. As the authorities had long tolerated associations formed in contravention of the law, the workmen now organized "societies of resistance," similar to those trades unions which are organized for trade purposes alone. Many of these were afterward affiliated with the international association. (See INTERNATIONAL ASSOCIATION.) In 1868 the government intimated that the various trades in Paris would be permitted to organize under the direction of syndical chambers, on condition of abstaining from politics. In 1875 there were about 100 such syndicates among the employers, and about 70 among the workmen. The latter were refused the privilege of forming a central committee, while the employers' syndicates have both a central committee and a newspaper organ.—In Belgium trades unions have become prominent within a few years past, and have made several vigorous strikes at the manufacturing centres. Switzerland has flourishing trades unions, which resemble the English societies, but several related trades are usually represented in one organization. They embrace both trade and benefit purposes, and take part in politics. The strikes among the Swiss unions from 1868 to 1873 inclusive varied from a few days to several months. In a fair proportion of cases the objects of the workmen were attained. In Italy trades unions have existed since about 1865, and several strikes have occurred. The strictness of the combination laws has depended a good deal on the pleasure of the tribunals charged with their execution. Coalition to raise or lower wages is made criminal only when entered into "unjustly or abusively," or "without reasonable cause." There are trades unions in other European countries, but they exercise little influence on industrial relations, and nowhere on the continent are these organizations so powerful as in the United Kingdom. While the laws of the continental countries repress combinations to raise wages, they encourage provident and mutual aid societies.—Though the working men of the United States have enjoyed unrestricted liberty of combination, the trades unions of this country do not compare with those of the United Kingdom in membership, resources, or discipline, nor in the extent to which they have combined beneficial objects with trade purposes. The following table comprises the principal unions with a national organization; all of these, except the miners' union, have branches in Canada:

| NAMES OF SOCIETIES. | Date of organization. | No. of branches. | No. of members. |
|---|---|---|---|
| International typographical union... | 1852 | 171 | 10,295 |
| Machinists' and blacksmiths' international union.................... | 1859 | .... | 8,000 |
| Iron moulders' union of North America.......................... | 1859 | 150 | 7,500 |
| Brotherhood of locomotive engineers | 1863 | 188 | 12,000 |
| Journeymen tailors' national trades union ............ ............... | 1865 | 40 | 2,800 |
| Coopers' international union........ | 1870 | .... | 5,000 |
| Cigar makers' international union.. | .... | 100 | 5,000 |
| Miners' national union.. ............ | 1873 | 347 | 35,355 |
| United sons of Vulcan.............. | 1874 | .... | 4,000 |

The miners' union comprises organizations which have existed for years in different states, of which the strongest was that of the anthracite miners of Pennsylvania. The membership of the national association is now distributed as follows: Pennsylvania, 20,840; Ohio, 4,734; Illinois, 5,122; Indiana, 2,135; Indian territory, 57; Iowa, 272; Colorado, 242; Wyoming, 544; Maryland, 431; Missouri, 547; Kansas, 123; Tennessee, 129; West Virginia, 178. The society of the "United Sons of Vulcan" comprises iron puddlers and iron boilers. The local unions are called "forges." In addition to the above there are the bricklayers' national union, the united order of American plasterers, the house painters, the hat finishers' association, the knights of St. Crispin (shoemakers), the order of morocco dressers, the journeymen horse shoers' union, the society of locomotive firemen, the mule spinners of the cotton factories, and the weavers, who in May, 1875, amalgamated their local unions into one association. There are also many local societies, some of which, especially among those in the larger cities, are of considerable importance. The financial panic of 1873 was followed by a large reduction in the membership of many of the unions. In New York city the aggregate membership in 1873 was 44,950; in 1874, 35,765. In 1871 the knights of St. Crispin had about 300 branches and 70,000 members; now they scarcely have a general organization, though many of the branches survive with a reduced membership.—In the national trades organizations of the United States, legislative power is confided to an assembly of delegates, to which each local union sends a number bearing a stated relation to its membership, and the action of these bodies is generally final. The principal exceptions are in the tailors' union and the iron moulders' union, in both of which questions are decided by a majority of the unions, and not as in England by a majority of individual voters. The assemblies of delegates elect the executive officers, usually for a term of one year. The qualifications for membership in the skilled trades usually include apprenticeship. In the typographical union the period required is four years. This union admits pressmen, and also charters local unions of pressmen. The iron moulders' union admits brass moulders on the same conditions as iron moulders, one of which conditions is the ability to earn the average rate of wages prevailing in the locality where the candidate is employed. The locomotive engineers require that the candidate shall be a white man, not less than 21 years of age, able to read and write, of temperate habits and good moral character, and possessing at least one year's experience as an engineer. The contributions in the American societies are generally small. Those of the tailors' union are but 10 cts. a month. Among the miners there is a strike fund, to which the contributions are 25 cts. a month. In several unions the initiation fees, and charges for new charters, travelling cards, &c., constitute the only sources of income for general purposes. In the brotherhood of locomotive engineers, the iron moulders' union, and some others, the benefit features, so largely developed in the English societies, appear to a limited extent. In most of the states the trades unions need legislation for the better security of their funds. The subject of a national law for this purpose, and also of legislation for the better protection of life in mining and other dangerous occupations, has been agitated. Nearly all of the societies above named declare themselves opposed to strikes except as a last resort, and several of them require their members to make an effort to settle disputes by arbitration, before applying to the society at large for authority to strike. A tendency toward federation has manifested itself among the trades unions of the United States, as in the organization of the workingmen's assembly of the state of New York, which however had but a brief existence. In February, 1876, an amalgamated association of iron workers was formed, embracing societies previously existing in different branches of the iron trade. The national labor union, organized at Baltimore in 1866, although assuming to represent the working men of the country, found comparatively little support among the trades unions, and gradually took the form of a political party. A national industrial congress was formed at Cleveland, O., in July, 1873. Besides an exchange of views between the representatives of the different industries, its objects included united action for legislation. Most of the large societies and many of the local unions were represented.—See Lemercier, *Études sur les associations ouvrières* (Paris, 1857); Brentano, *Die Arbeitsgilden der Gegenwart* (Leipsic, 1871 *et seq.*); the count de Paris, *Les associations ouvrières en Angleterre* (French and English, 1869); Nadaud, *Histoire des classes ouvrières en Angleterre* (Paris, 1872); Leroy-Beaulieu, *La question ouvrière au XIX^e siècle* (Paris, 1872); Bamberger, *Die Arbeiterfrage* (Stuttgart, 1873); and Mazaroz, *Les chaînes de l'esclavage moderne* (Paris, 1876).

**TRADE WINDS,** the prevailing N. E. and S. E. winds, in the northern and southern hemispheres respectively, that blow from the par-

allels 30° N. and S. toward the equator. They are atmospheric currents moving toward the equator to fill the spaces left by the airs that have become heated and passed up to the more elevated portions of the atmosphere in the belt of the equatorial calms. These currents, moving continually toward larger parallels of latitude, do not at once acquire the increasing eastwardly movement of the portions of the earth's surface revolving beneath, and the lagging occasioned by the earth slipping away under them produces a deviation from a direct meridional movement as respects the surface of the earth, and an apparent progress of the currents toward the west. Beyond the limits stated above these currents merge into the regions of variable winds and calms. (See METEOROLOGY, and RAIN.) The trade winds have been known to Europeans since the end of the 14th century; to them Columbus owed his prosperous voyages to America, and they constitute a most important factor in the navigation of the ocean. The limits within which the trades prevail vary from month to month with the varying position of the sun, the range being about ten degrees. In general the trade wind is not accompanied by clouds, and the air is comparatively dry.—See Maury's, Fitzroy's, and Andrau's trade-wind charts, the admiralty wind charts, and Coffin's "Winds of the Globe," to be published in 1876 by the Smithsonian institution; also Ferrel's "Motions of Fluids and Solids" (New York, 1860).

**TRAFALGAR** (anc. *Promontorium Junonis*), a cape of Spain, on the S. W. coast, at the N. W. entrance of the strait of Gibraltar, in lat. 36° 10′ N., lon. 6° 1′ W., about 28 m. S. E. of Cadiz. It is memorable for the naval battle fought near it, Oct. 21, 1805, between the English under Nelson and the combined fleets of France and Spain. (See NELSON, HORATIO.)

**TRAGACANTH.** See GUM, vol. viii., p. 321.

**TRAGOPAN,** a name given by Cuvier to the birds of the pheasant family comprised in the genus *ceriornis* (Swains.). The bill resembles that of the common fowl; the wings are ample and very concave, with the fourth to the seventh quills the longest; tail rounded, and its coverts ample; tarsi stout and armed with a small spur, anterior toes united at the base by membrane, and the claws long and curved. There are three or four species, inhabitants of the gloomy and thick pine forests of the high mountains of central Asia; they are solitary and shy, and discoverable only by their shrill whistle; the plumage is very brilliant, being red, varied with black, blue, and golden, and with white eye-like spots. The best known species is the horned pheasant (*C. satyra*, Swains.), of the size of a large domestic fowl; the males have the sides of the head naked, and in the spring behind each eye a long reddish and bluish horn directed obliquely backward, and under the throat long, naked, bluish, expansile wattles; the feathers are lengthened and disunited on the crown, purplish black, becoming crimson on the occiput; back of neck and bare skin in front surrounded by deep black; wings and back brown with an eyed white spot at the end of each feather;

Horned Pheasant (Ceriornis satyra).

rest of plumage deep red with small spots of white; the female and young are brownish, and have neither the horns nor the wattles; the males do not attain the full beauty of their plumage till the third year. The food consists of grains, roots, insects, and larvæ. There are also the golden-breasted and black-headed tragopans, similar to the preceding.

**TRAGUS, Hieronymus,** the Latin name of a German botanist, whose real name was Bock, born at Heidersbach in 1498, died at Hornbach in 1553. He was successively head of a school in Zweibrücken and superintendent of the ducal garden, Protestant pastor at Hornbach, and physician of the count of Nassau in Saarbrück. He published *Neues Kräuterbuch vom Unterschiede, Wirkung und Nahmen der Kräuter, so im Deutschland wachsen* (fol., Strasburg, 1551; Latin translation by Kyber, 1552). This was the first attempt in modern times toward the classification of plants.

**TRAILING ARBUTUS.** See ARBUTUS.

**TRAJAN** (MARCUS ULPIUS TRAJANUS), a Roman emperor, born in Italica, near Seville, Spain, Sept. 18, A. D. 52, died in Selinus (afterward called Trajanopolis), Cilicia, in August, 117. He was the son of Trajanus, an officer in the imperial service, and early embraced the profession of arms. He served as a military tribune in the wars of the East, before 86 was made prætor, and in 91 became consul along with M. Acilius Glabrio. Afterward he went to Spain, and was sent by Domitian to Germany to command the troops on the lower Rhine. When at the close of 97 Nerva adopted him and chose him as his successor, the selection met with general acquiescence, although no previous emperor had been born out of Italy. His title after his elevation

to the imperial dignity was Imperator Cæsar Nerva Trajanus Augustus. In January, 98, Trajan, who was then encamped at Cologne, succeeded to the throne; but for many months he did not go to Rome, being engaged in war on the frontiers of the Rhine and the Danube. He entered Rome amid the acclamations of the people, and soon received, for his efforts to ameliorate the condition of the poor and to improve the judicature, the title of Pater Patriæ, and the new designation of Optimus. In 100 the younger Pliny, who was his warm personal friend, pronounced his panegyric upon him. In 101 Trajan crossed the Danube, defeated Decebalus, the Dacian monarch, took many of his strong posts and his capital Sarmizegitusa, and, having compelled him to sue for peace, returned to Rome in triumph with the title of Dacicus. In 104 Decebalus broke his treaty, refused to comply with the emperor's demand that he should surrender himself, and when Trajan marched against him first attempted to poison his enemy. The conquest of Dacia was now determined upon, and an immense bridge was built across the Danube, over which the Roman army passed into that country. This bridge was the largest work of the kind ever built by the ancients, and, according to Dion Cassius, consisted of 20 piers, 150 ft. high, 60 ft. wide, 170 ft. apart, and united by wooden arches; it was probably in the neighborhood of the modern town of Tchernetz in W. Wallachia. Decebalus was defeated at all points, and in despair killed himself (106); Dacia was reduced to the condition of a Roman province, and fortified posts were built and colonists settled in it (107). When the emperor returned to Rome, he exhibited to the people games which lasted 123 days, and in which 11,000 animals were killed and 10,000 gladiators fought. In the following years he carried on a campaign against the Parthians and Armenians, and was engaged in numerous military expeditions, the history of which is almost altogether lost. In the spring of 115 he marched against the Parthians, having previously received the submission of Armenia and the princes of the neighboring countries. He crossed the Tigris on a bridge of boats, subdued the country beyond that river, and returned to Antioch the same year. In 116 he again marched to the Tigris, and sailed down that stream to the Persian gulf, but was recalled by a general uprising in the provinces which he had reduced. Arriving at Ctesiphon, he gave the Parthians a king whom they quickly expelled. After the siege of Atræ in Mesopotamia he fell sick, and, leaving his successor Hadrian in command in Syria, started for Italy, but died on the way. His ashes were carried to Rome in a golden urn, and placed under the column bearing his name, which he had erected in honor of his Dacian victories.—For many generations afterward Trajan's reign was looked upon as the most brilliant in the imperial annals. The Roman arms were carried further than ever before or after, and rarely suffered defeat. Besides the conquests in Dacia and beyond the Euphrates, Arabia Petræa was made subject to the empire by A. Cornelius Palma, the governor of Syria. Nor were his works for the internal improvement of his dominions less important. He constructed an artificial harbor at Centum Cellæ (now Cività Vecchia), built the port of Ancona, made several great roads in various parts of the empire, one of which was across the Pontine marshes, and erected magnificent bridges. He founded several libraries in Rome, one of which, called *Ulpia Bibliotheca*, was very celebrated; built a theatre in the Campus Martius, and also the Forum Trajanum, his great work, in the centre of which was the column of Trajan, erected in 112. It has been alleged that he was intemperate and licentious. Many writers doubt the magnitude of the persecution of the Christians which is said to have taken place during his reign. His correspondence with the younger Pliny, governor of Bithynia and Pontus, concerning the treatment of Christians, displays an unusual consideration for justice and humanity. In his reply to Pliny he says: "You have adopted the right course, my friend, with regard to the Christians; for no universal rule, to be applied in all cases, can be fixed in this matter. They should not be searched for; but when accused and convicted, they should be punished; yet if any one denies that he has been a Christian, and proves it by action, namely, by worshipping our gods, he is to be pardoned upon his repentance, even though suspicion may still cleave to him from his antecedents. But anonymous accusations must not be admitted in any criminal process; it sets a bad example and is contrary to our age."

**TRALL, Russell Thacher,** an American physician, born in Vernon, Tolland co., Conn., Aug. 5, 1812. His parents removed to western New York in his childhood. He studied medicine, and for some time practised the profession in accordance with the standard system. In 1840 he removed to New York, where in 1843 he opened a water-cure establishment; and in 1853 he established a medical school for pupils of both sexes, called the "New York Hygeio-Therapeutic College," since removed to Florence, N. J. He has edited the "Hydropathic Review" and other periodicals devoted to hydropathy and temperance, and has published "Hydropathic Encyclopædia" (New York, 1852); "Hydropathic Cook Book" (1854); "Prize Essay on Tobacco" (1854); "Uterine Diseases and Displacements" (1855); "Home Treatment for Sexual Abuses;" "The Alcoholic Controversy;" "The Complete Gymnasium" (1857); "Diseases of the Throat and Lungs" (1861); "Handbook of Hygienic Practice" (1865); "The True Temperance Platform" (1864); "Sexual Physiology" (1866); "Water Cure for the Million" (1867); "Digestion and Dyspepsia" (1874); "The Human Voice" (1874); and "Popular Physiology" (1875).

**TRANI,** a town of S. Italy, on the Adriatic, in the province and 27 m. W. N. W. of the city of Bari; pop. in 1872, 24,388. It is the seat of an archbishop, and has an ancient and celebrated cathedral with one of the loftiest towers in Italy. The harbor was formerly very deep, but is now accessible only to small vessels. The trade is chiefly in oil, wine, grain, almonds, and figs.

**TRANQUEBAR,** a town of British India, in the district of Tanjore, Madras, on an island at the mouth of the river Cavery, 147 m. S. by W. of Madras; pop. about 25,000. There are Lutheran churches, a Roman Catholic chapel, and several schools. Tranquebar has some manufactures of cotton cloth, oil, and soap. It belonged to the Danes, but was ceded to the British in 1845.

**TRANSCAUCASIA.** See CAUCASUS.

**TRANSCENDENTAL** (Latin *transcendere*, to go beyond), in metaphysics, a term applied in general to ideas and doctrines that are not suggested or limited by experience. In the scholastic philosophy, *transcendens* and *transcendentalis* designated anything that was not *prædicamentalis*, that is, anything that rose above, was not comprehended in, and could not be defined by, either of the ten *summa genera* or categories of Aristotle. Thus, being was transcendental, and only some category of being was prædicamental. Kant gave new and distinct significations to *transcendens* and *transcendentalis*. The former designated what is wholly beyond experience, is conceivable neither *a priori* nor *a posteriori*, and thus lies beyond every category of thought. The latter designated *a priori* conceptions and judgments, which are necessary and universal, and which transcend the sphere, while affording the conditions, of the contingent knowledge furnished by experience. Thus by the transcendental, formal, or critical philosophy of Kant is meant his system of the principles of the pure reason, which occupies itself not with the objects or matter of knowledge, but with the subjective ideas or forms, as time, space, substance, and causality, through which objects are represented to us as phenomena. Objects in themselves (*Dinge an sich*) he deemed transcendent.—In mathematics, transcendental quantities are those which cannot be expressed by a finite number of algebraic terms, but are represented by means either of logarithms, or variable exponents, or some of the trigonometrical functions. Transcendental curves, as the logarithmic spiral, are those whose equation is transcendental, *i. e.*, expresses a relation between transcendental quantities.

**TRANSFUSION OF BLOOD,** the operation of introducing into the vascular system of one animal blood taken from the vessels of another. This operation was suggested and described by Libavius early in the 17th century, but it was first successfully practised by Richard Lower in England in 1665. Some years previously it had been ascertained by Robert Boyle that various medicinal substances might be injected directly into the blood vessels of the living dog, with the result of producing their specific effect upon the animal system, as if they had been introduced by the stomach. Lower's experiments were also performed upon the dog, by connecting, by means of a tube, the carotid artery of one animal with the jugular vein of another, the vein of the second dog being allowed to remain open above the point of connection. Thus the blood lost by the second dog was supplied by that coming from the carotid artery of the first. The consequence was that the animal into whose vessels the blood was introduced in this way by transfusion remained uninjured, while the other died of exhaustion from hæmorrhage. These experiments encouraged the idea of performing a similar operation upon the human subject. This was first done in France in 1666 by Denys and Emmerets. They believed that the operation might result in the cure of chronic diseases by introducing into the veins of the patient healthy blood from a foreign source; and accordingly they transfused the blood of a sheep for this purpose into a man. The first results were said to have been so favorable as to excite the most extravagant anticipations, and to create great enthusiasm in the minds of the medical profession in favor of the operation. But these promises were not fulfilled, and as several instances occurred soon afterward where the operation was followed by bad consequences, there was a corresponding reaction against it, and in 1668 the parliament of Paris forbade its repetition except by special consent of the faculty. In 1818 the operation of transfusion was again taken up by Dr. Blundell of London, who carefully experimented upon it as applied to its original and legitimate object, namely, the restoration of life after exhausting hæmorrhage. He performed 33 experiments upon dogs, and established by them the following facts: 1, that dogs, when exhausted by hæmorrhage, may be resuscitated, even after momentary stoppage of the respiration, by injecting the blood of other dogs; 2, that human blood injected into a dog, in sufficient quantity to supply the loss caused by abundant hæmorrhage, produces a temporary reanimation, but does not save life, as the dog dies some hours afterward; 3, that the transfusion of blood, whether arterial or venous, will be successful if the two animals belong to the same species; 4, that the blood used in transfusion need not be conveyed directly from the vascular system of one animal to that of the other, but may be received into a cup and passed through a syringe, without being thereby rendered unfit for the purposes of life. The operation was thus placed upon its proper footing, and one of the important conditions for its success brought into notice; namely, that the blood used for transfusion should belong to an animal of the same or at least a kindred species. This explained in great measure the

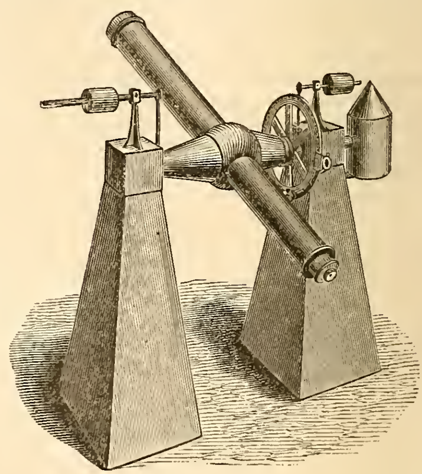
bad results of the earlier operations, in which the blood of the sheep had been introduced into the veins of the human subject. This fact was still further elaborated by subsequent experimenters. If the animals used for experiment belong to different classes, as where the blood of a quadruped is introduced into the veins of a bird, or that of a bird into the veins of a quadruped, even in small quantity, it appears to have an actually poisonous effect, and death follows in a very short time. If the animals belong to the same class, but are not of the same genus, as where the blood of the cow or the sheep is introduced into the vessels of the cat or the rabbit, or human blood into those of the dog, there is a temporary reanimation, but noxious effects afterward follow, and death occurs at the end of some days. These noxious results appear to be due in great measure to the presence of the fibrine of the blood; for if this be removed by beating the fresh blood before its injection, they do not follow, or at least are much less strongly marked. Nevertheless, the blood of animals belonging to a different class, even when defibrinated, though no longer actually poisonous, does not resuscitate or preserve the animal experimented on from the effects of hæmorrhage. To secure this beneficial effect, the animals must be within certain limits of consanguinity. If the blood be used fresh, they must belong to the same species; and if it be defibrinated, they must still belong to the same genus. Furthermore, it is found that the red globules of the blood are essential to its vivifying influence. The fibrine may be removed without injury, and in some cases, as above mentioned, even with benefit. But the injection of serum alone, that is, blood deprived of both fibrine and globules, is useless as a means of preserving life.—With these improvements the operation of transfusion has been successfully applied to the human subject. After an abundant hæmorrhage there is frequently an interval, often of several hours, during which, although the hæmorrhage may have ceased, the patient is evidently sinking, and other means of restoration are of no avail. It is to such cases that the operation of transfusion is adapted. Bérard has recorded 14 instances of this kind, most of them cases of hæmorrhage after delivery, in which the life of the patient was saved by this means. There are certain rules which it is important to observe: 1. In transfusion in the human subject, it is of course human blood that should be used, supplied by a healthy, vigorous person. 2. But a small quantity, namely, from two to four ounces, should be injected at a time. This amount is generally sufficient; if not, the injection may be repeated after an interval. All that is required by the transfusion is to restore the patient to consciousness and bring him into such a condition that he can take and appropriate nourishment and stimulus. 3. If the injection be made by a syringe, great care should be taken that the blood be not allowed to fall below its natural temperature of 100° F., and especially that no bubbles of air become entangled with it and thus introduced into the veins. 4. The injection should be made slowly, and terminated as soon as the requisite effect has been produced. 5. The delay should not be so great as to incur the risk of the blood becoming coagulated, either in the syringe or within the veins of the patient.

**TRANSIT,** in astronomy, the passage of a planet across the disk of the sun, or of a satellite across the disk of its primary; also, the passage of a heavenly body across the meridian of the place of observation, sometimes called its culmination. Of the planets, only Mercury and Venus, having orbits within the orbit of the earth, can present this phenomenon. The transits of Venus are employed for the determination of the sun's distance; they recur at alternate intervals of 8 and 105½, and 8 and 121½ years. The earliest transit of the sun's disk of which we have an account is that of Venus in 1639, predicted and observed by Jeremiah Horrox, an amateur astronomer of Lancashire, England. The transits of the last century, in the years 1761 and 1769, were observed with great care, expeditions having been equipped for the purpose by the chief European states. But the results then obtained were not so trustworthy as had been anticipated. Two methods of observation were relied on, both depending on time, though not in the same way. It had been suggested by Halley, early in the century, that instead of observing the position of Venus on the sun's face at any assigned instant (for the purpose of thence determining her relative parallactic displacement and so her distance), the observers should note the interval of time occupied by the planet in completing her transit. As the effect of parallax would be to cause her to traverse different chords, as seen by observers at northern and at southern stations, there would result a difference in the duration of transit, the amount of which would enable astronomers to deduce the sun's distance. Delisle, when the transit of 1761 was approaching, discovered that there would be on that occasion disadvantages in applying Halley's proposed method, which requires that both the beginning and end of the transit should be seen; and he proposed another method, requiring only that one or other of these phases should be noted. According to this plan, two observers were both to note the beginning (or else both to note the end), one observing the phase where it occurred as early as possible, and the other observing it where it occurred as late as possible; then, by noting the difference of time between their two observations, they would be able to estimate the sun's distance. Halley's method was manifestly the easier, since each observer had to note the duration between two phenomena both of which were observed by him, and the difference be-

tween the two durations thus noted could be determined at once; whereas in Delisle's method each observer had to determine the absolute time of a single phenomenon, and a comparison between their results could only be effected satisfactorily if these results could be referred to some common standard time of reference, as Greenwich or Paris time. But in the actual application of both methods another difficulty obtruded itself into notice. It was found that the moment when Venus was in internal contact, either at ingress or egress, could not be determined, as Halley had hoped, within a single second, or indeed within several seconds. Accordingly doubt had long rested on the determination of the sun's distance obtained from the observations made in 1761 and 1769. In fact, from the first, the results were found to be widely discordant according to the manner in which the observations were interpreted. The values of the sun's distance deduced from the transit of 1761 ranged from 77,846,000 m. to 96,163,000 m.; those deduced from the transit of 1769, though not ranging quite so widely, yet differed by more than 4,000,000 m., the greatest being as before 96,163,000 m., the least 92,049,650 m. Strangely enough, all this was forgotten when (after Encke had published his result from the combination of both series of observations, viz., 95,265.000 m.) a long period had elapsed during which the text books and ephemerides had published the same value for this important element. Accordingly, much surprise was expressed when other methods of observation showed that this value so long received was too great by three or four million miles, the true value appearing to be nearer 92,000,000 m. Although this surprise was by no means justified by the facts of the case, yet it was natural that much attention should be attracted to the transits of 1874 (Dec. 8) and 1882. Accordingly great preparations were made for the observation of the earlier transit, the United States in particular taking a distinguished part in the work. It has been estimated that nearly $1,000,000 must have been expended on the various expeditions. Stations were occupied in Siberia, China, Japan, the Hawaiian islands, northern India, Persia, Turkistan, and Egypt in the northern hemisphere, and at a number of islands in the Indian and Southern oceans, from Kerguelen on the east to Chatham island and New Caledonia on the west, Australia, Tasmania, and New Zealand being also occupied in force. Various success attended the observers, but on the whole the results obtained were excellent. Delisle's method and Halley's, the heliometric method, and photography were applied at many of the most important stations; and though bad weather prevailed at other stations, the object of the expeditions was achieved. So far as can be judged at present, the sun's distance indicated by these observations is about 92,000,000 m. The next transit of Venus will occur Dec. 6, 1882, and is looked forward to with great interest for verifying these determinations.—The transits of Mercury are much more frequent than those of Venus, in consequence of the former planet being nearer the sun, and having thus a narrower orbit and a shorter year; but they are not available for the determination of the solar parallax. The transit of stars is employed in the determination of longitude. (See LONGITUDE.) The precise relative situation of the heavenly bodies in respect to their right ascension is determined by comparing their exact times of transit. For the means by which these times are ascertained see TRANSIT CIRCLE.

**TRANSIT, Engineer's.** See THEODOLITE.

**TRANSIT CIRCLE,** an astronomical instrument for determining the absolute positions of the heavenly bodies. As these positions are given by two independent elements, the right ascension and declination, corresponding to geographical longitude and latitude, so this instrument is a combination of two independent



Transit Circle.

constructions, each giving its share to the name of the whole, and each furnishing its corresponding element by independent and yet simultaneous observation. The transit circle now forms an essential part of the equipment of every well constituted observatory. The two constructions which have here combined their powers are the transit instrument and the meridian or vertical circle. The former consists of a telescope whose tube is composed of two slightly conical portions firmly secured at their bases to opposite sides of a hollow central cube, from two other opposite sides of which proceed also equal cones of more massive make, generally indeed cast in the same piece with the cube, and forming an axis at right angles with the telescope. At or near the extremities of this axis are two perfectly cylindrical, highly finished pivots of hardened steel, corresponding in position to sockets resting upon stone columns which, based firmly in the ground,

exactly east and west of each other, and rising to a convenient height, support the instrument so that the telescope revolves freely between them in the plane of the meridian. This gives the simple transit instrument, by which and its necessary accompaniment, the clock, is observed the time of meridian passage (the transit) of the star whose place is to be determined. If now we attach firmly to the axis a finely graduated circle which will revolve with the telescope, we shall be enabled, by means of its divisions, to measure also the precise altitude of the star at the same instant of culmination; and thus the transit circle will give, by the first observation, the desired right ascension, and by the second, the desired declination of the object. This combination is entirely of modern date. Transit instruments and meridian arcs and circles have been used ever since the days of Roemer and Picard, but the first real conjunction of the two dates from the close of the first quarter of the present century.—The sockets of the transit circle receive the pivots and determine the position of the instrument. They are not formed, as might be supposed, of circular "boxes" accurately fitting the pivots, but are simply solid little pieces of gun metal, cut away at the upper surface by two planes inclined to each other like the sides of the letter V, from which letter they take their technical and convenient name. In these V's the pivots revolve smoothly and truly, touching the inclined sides at but two points, and consequently without the lateral play which it would be impossible to avoid in circular boxes, however truly ground. Again, the stone piers upon which the instrument rests, even though wrought into perfect symmetry and equality in every respect, and though posited in such a manner as to furnish no apprehension of relative change, will yet continually manifest such change, sometimes under the influence of varying temperature from day to night and night to day, but more frequently from causes even more irregular and less known than this. In order therefore to be able to keep the axis of the instrument duly east and west and truly horizontal, the V's are not permanently bedded in the stone, but are so held by strong plates of the same material, themselves permanently fastened, as to allow of small changes of position, one in a horizontal and the other in a vertical direction. Passing next to the telescope, we notice that the narrower ends of the tapering tubes are terminated by flat rings of precisely the same dimensions, upon which are fitted caps containing, one the object glass and the other the eye tube with its mechanisms. These caps are exactly of equal weight, and, partially entering the ends of the tube, their centres of gravity fall truly in the line of junction with the telescope. Thus the instrument is not only perfectly counterpoised, but also, the caps being convertible, the object glass and eye tube may be and should be periodically interchanged, in order to eliminate from an average result the effect of a possible flexure of the tube. The object glass presents nothing worthy of especial remark. The construction of the eye piece is peculiar. The term "eye piece" is generally, though incorrectly, applied to the whole mechanism at the eye end of the telescope, which consists of a small tube sliding in the end cap, and carrying not only the eye piece proper, which is of the form known as Ramsden's (see TELESCOPE), but also a conveniently shaped box containing two thin metallic plates. These plates, called diaphragms, are made with central openings, across which are stretched the threads used to mark the star's position in or its progress through the field. One of these diaphragms is used for the observation of transits, and is securely held in place by fine "antagonist" adjusting screws. Across its opening and precisely through the centre of the field is stretched vertically a most delicate thread of spider's web, which, as the instrument revolves, represents to the observer's eye the meridian as a visible line across which the heavenly bodies are seen to pass at the moment of culmination. In order to gain more accuracy in this observation (for the instant of transit is required to be known within a small fraction of a second), other threads are also introduced parallel with the central one and symmetrically disposed on either side of it, so that, by noting the time of crossing each and taking the average, a very great degree of accuracy is attained. Ordinarily the transit diaphragm contains either five or seven threads, all at equal intervals; but for special purposes their number and arrangement are adapted to the circumstances. With a telegraphic method of registry, as practised with the large transit instrument of the Washington observatory, five different sets or tallies, with five threads in each, are sometimes used. Across the same diaphragm is stretched horizontally another fixed thread, as a guide to the observer in placing the telescope so that the star shall traverse the centre of the field. The second diaphragm, carrying only a single horizontal thread, is movable in a vertical direction between truly fitting guides, and by means of a finely wrought micrometer screw. As the first plate belongs to the transit portion of the twofold construction, so this one belongs to and coöperates with the circle, and the office of the screw which carries it is to measure the exact distance of the star, as it traverses the field, either from the fixed horizontal thread, or from some other definite starting point, which may be represented upon the scale of the screw without being necessarily visible. Attached to the screw and revolving with it is a small disk or "head," whose edge is divided into 100 equal parts, so as to measure very accurately the fractions of a revolution, while the whole number of turns necessary to carry the thread to any part of the field is registered upon a convenient scale usually placed within the eye

piece and visible with the threads themselves. In order to render thread and scale visible by night, various contrivances are used, the most common of which is to introduce a flat oval ring with whitened surface into the central cube, and with its plane inclined at an angle of 45° with the axis, so that, receiving light thrown in through an orifice in the pivots, it will reflect sufficient into the field to show the threads as black lines upon a bright ground. Sometimes also the illumination is thrown upon the threads themselves, when they appear as bright lines upon a dark ground; and in the great transit circle at Greenwich a very ingenious combination of prisms enables the observer to produce either effect at pleasure.—Upon each half of the axis, between the cube and the pivots, is a circle whose diameter is usually from one third to one half the length of the telescope. These circles with their several radii and cross bars are generally cast each in a single piece, to insure greater firmness and avoid unequal tensions. But the six-foot circles of the Greenwich instrument just mentioned, weighing about 300 lbs. each, are made of two castings, the rim in one, and the whole system of radii and braces in another, the two being afterward firmly bolted together at 12 equidistant points. Upon a narrow band of silver inserted near the circumference of the circles are cut the graduations required for the special office of each; one, used only for pointing the telescope in any given direction, is divided so as to read with a vernier to single minutes, which is abundantly sufficient; the other circle, intended for the exact measurement of angles, is divided with the most scrupulous accuracy into arcs of two, three, or five minutes, as the case may be, and, once fixed upon the axis, should never during observations be handled or subjected to unequal pressure or strain of any sort. Assuming now that these division marks are truly cut, we next look for the means of subdividing the small arcs into seconds and fractions of seconds, and find this accomplished by a system of "reading microscopes." These are microscopes of the ordinary compound construction, but each provided with a micrometer screw carrying, as in the German instruments, a pair of close parallel threads between which the image of the division under consideration can be placed with great accuracy, or, as in Troughton's form, two threads crossing each other at a very acute angle, which may be bisected by the division. The microscopes are so made that one revolution of the screw is equal to a minute, and the micrometer head is divided into 60 equal parts, each of which therefore represents a second. There are usually four of these microscopes placed 90 degrees apart; but sometimes as many as six are used for greater certainty, both from the greater number of readings and from the probable reduction of the systematic errors of the primary division. The proper method of supporting these microscopes to insure their perfect stability has been a subject of much study. A favorite plan has been to place them on the periphery of another smaller circle which rests, accurately fitting, upon the axis itself, but is prevented from revolving with it by a small projecting bar caught below between two screws attached to the pier. Experience, however, seems to have decided in favor of securing firmly and independently upon the pier itself, near the V-plate, a solid block of metal which serves as the centre of a strong square frame at whose corners the microscopes are attached by adjusting screws. The microscopes are thus entirely disconnected from the circle; and although every new adjustment of the axis will show itself in their record of the graduations, yet this produces no effect whatever upon the mean of readings of opposite microscopes. In the Greenwich instrument, whose piers are broader than the circles themselves, the microscopes are very long, and are passed through the pier itself, converging from the rim of the circle until their eye pieces are collected within a very small space, where the observer reads them with convenience and ease. The graduated limb is bevelled to suit this arrangement, and from another point near the observer a small gas-burner radiates light through other openings in the pier in such a manner as to illuminate uniformly the field of each microscope; a matter of very high practical importance.—To bring the instrument into its proper place in the meridian, it is necessary that the middle vertical thread of the fixed diaphragm be placed truly in the optical axis of the telescope, which is the central line of the cone of rays converging from the object glass. This may be effected by turning the telescope to a very distant fixed object, noting the exact position of this middle thread with reference to the images in the field, and then reversing the instrument, when the thread will probably occupy a different position, whereupon it must be brought by the adjusting screws of the diaphragm to a point midway between the first and second places, and the operation repeated until no change appears upon reversal. Next, by means of a spirit level and the vertical adjusting screws of one of the V-plates, the axis of the instrument is rendered truly horizontal; and finally, the approximate sidereal time being known, the telescope is directed to some star, also known, very near the pole of the heavens, and the axis moved by the horizontal adjusting screws of the other V-plate, until at the right moment the star and thread coincide exactly. The three errors thus corrected are denominated the errors in collimation, level, and azimuth respectively. And now, by help of stellar observations under properly varied circumstances, we are able not only to determine with great precision the small outstanding values of these errors, which by no means remain constant for any length of time, but also to judge the clock that aided us, and finally the

very places of the stars that have served as our guides. The errors of instrument and clock having been thus determined, it is possible, by the aid of formulas and methods which have been so thoroughly developed and systematized as to be applicable with the greatest facility, to obtain by a single observation of any new object its right ascension within a very small fraction of a second of time.—But, as we have intimated, the chief value of the instrument consists in its power of furnishing at the same culmination not only the right ascension but also the declination of the object, and it accomplishes the latter most simply in the following manner. While the observer is noting the progress of the star across the transit threads, he at the same time, by a delicate movement of the telescope in altitude, places it so that the star appears to run along the fixed horizontal thread; and then, the transit observation having been completed, he reads, even to the fraction of a second, from the circle microscopes the precise point corresponding to the apparent altitude of the star. Or, a still more accurate determination is obtained by placing the telescope so that the star will traverse the field at a little distance above or below the fixed thread; and there is ordinarily time enough to bring the movable thread several times into coincidence with the star's image by means of the micrometer screw, always noting its indications and afterward taking the mean of all. The small distance from the fixed thread, as thus measured, must of course be duly applied as a correction to the readings of the microscopes, and thus we derive one extremity of the desired arc, and then proceed to find the other. In order to know the star's declination, we must first have its altitude above the horizon. This can sometimes be obtained by a double observation of the star's image, first as reflected from a quicksilver surface, and then as seen directly, in which case the arc included between these two directions is obviously equal to twice the altitude of the star; but this course is not always applicable. We have however a readier and exquisitely beautiful method of obtaining with very great accuracy the direction of the vertical line, from which we can count the star's zenith distance. The telescope being turned so as to look directly downward, we place immediately beneath it a vessel of quicksilver; and if then, by means of a small plate of thin glass held at an angle of 45°, we reflect a strong light down the telescope, it will be reflected back by the quicksilver, and, looking through the glass from above, we shall see not only the threads in the eye piece, but also the reflected image of each; and by moving the instrument carefully until the fixed horizontal thread coincides with its own image, we shall have the telescope mathematically vertical, and may read from the circle the corresponding second point of the desired arc, whereby we obtain the apparent altitude, and thence, correcting for refraction, the true altitude, and finally the desired declination.—A few words must be added respecting the use of transit instruments in the prime vertical, that is, so placed that the great circle described by the collimation axis is in the prime vertical. Bessel first suggested this method of mounting a transit instrument, for the purpose of determining with special accuracy the latitude of the place of observation. It is manifest that any star which has a north declination less than $l$, where $l$ is the latitude, crosses the prime vertical at equal altitudes on the eastern and western quadrants. If the interval in time between these passages be noted as $=2t$, it is manifest from the right-angled spherical triangle having for its angles the pole, the zenith, and the star's place in either quadrant of the prime vertical, that $\tan l = \tan \delta \sec t$. This method of determining the latitude has a great advantage in the readiness with which instrumental errors may be got rid of, by using the instrument alternately in opposite positions as respects the rotation axis. The adjustments for a transit instrument in the prime vertical relate, like those of the meridional transit instrument, to the three points, collimation, level, and azimuth. In collimation the adjustment resembles that of the ordinary transit instrument. The instrument is brought nearly into the prime vertical by directing it to a star of small northerly declination at the calculated time of the star's passage of the prime vertical. When this has been done, the rotation axis must be carefully levelled, and a fresh adjustment made by means of another star. For the small adjustment thus rendered necessary provision is made by allowing one of the V's a small motion in azimuth. Another method is to have the instrument provided with a graduated horizontal circle, and then, having adjusted it in the meridian, to revolve it through 90° in azimuth. When the rotation axis is in the meridian but inclined to the horizon, a correction can be readily made for this inclination, because the great circle described by the collimation axis crosses the horizon at the true east and west points, but passes slightly to the north or to the south of the true zenith; and the latitude found by means of the instrument corresponds to the latitude of the point where the great circle thus swept out crosses the meridian. Thus the only required consideration of the level correction is that this correction should be applied directly to the latitude found from the instrument used as if correctly adjusted. But if the rotation axis is neither in the meridian nor level, or if the middle thread is not in the collimation axis, the correction is less simple. (See Chauvenet's "Spherical and Practical Astronomy," vol. ii., p. 242.)

**TRANSUBSTANTIATION.** See LORD'S SUPPER.

**TRANSVAAL REPUBLIC.** See BOERS.

**TRANSYLVANIA** (Hun. *Erdély;* Ger. *Siebenbürgen*), a grand duchy of the Austro-Hun-

garian monarchy, now forming part of the lands of the Hungarian crown, bounded W. and N. by Hungary proper, N. E. and E. by the Bukowina and Roumania, and S. by Roumania. It is situated between lat. 45° 12′ and 47° 42′ N., and lon. 22° 24′ and 26° 30′ E.; area, according to the last changes of the frontiers, 21,216 sq. m.; pop. in 1870, 2,115,024. Capital, Klausenburg. The country is surrounded on all sides by mountains belonging to the Carpathian system, and the surface is much diversified, being traversed by several mountain ranges, between which there are numerous fine valleys and plains. The principal chain extends along the E. and S. frontiers, and sends out many offsets. The range which forms the N. W. boundary toward Hungary is properly designated as the Transylvanian Ore mountains. The most elevated points lie near the S. boundary, in the so-called Transylvanian Alps, where Mt. Negoi has a height of more than 8,000 ft. above the sea, and Mt. Bucsesd is very little lower. The Tömös, Red Tower, and Vulcan passes lead through this range. The whole drainage belongs to the basin of the Danube, the chief rivers being the Aluta (Hun. *Olt*), the Maros with its tributaries the Great and Little Kokel (*Küküllö*), the Bistritz (*Beszttercze*), the Szamos, and the Körös. There are several lakes.—The climate varies greatly according to elevation. In the valleys the heat of summer is very great, but in the more elevated districts the winter temperature is remarkably severe and so long continued as to cause serious injury to vegetation. Gold is found in most of the streams in greater or less quantities; a number of gold mines are worked, and are said to be very productive. Silver mines are also worked, and there is one of quicksilver. Copper, lead, iron, antimony, arsenic, tin, coal, alum, bitumen, saltpetre, and salt are all found; together with crystals and valuable pebbles, including garnets, chrysolites, amethysts, chalcedonies, agates, carnelians, and jaspers. A bed of rock salt extends in a belt 60 to 80 m. wide through the whole country, from which great quantities are extracted, as well as from numerous springs. In the more elevated parts vegetation is scanty, but lower down luxuriant forests make their appearance, which yield many kinds of valuable timber. The valleys and plains are particularly fertile, and, although agriculture is in a backward state, yield good crops of various kinds of grain, pulse, maize, hemp, flax, tobacco, saffron, and madder; and the vine and fruits are very generally cultivated. Great numbers of horses, horned cattle, buffaloes, sheep, and pigs are reared, large herds of the last named being fed in the forests. Game is abundant, and the rivers are well supplied with fish. The manufactures consist principally of coarse linen and woollen goods, native silk, different kinds of metals, paper, gunpowder, leather, porcelain and earthenware, glass, stearine candles, soap, furniture, and numerous articles in wood.—The population is composed of various races, including Magyars or Hungarians proper, Szeklers, Saxons, Roumans or Wallachs, Ruthenians, gypsies, Armenians, Greeks, Jews, and Bulgarians. The Roumans are by far the most numerous, being about three fifths of the whole. The gypsies number about 88,000. The religions most numerously professed are the non-united and united Greek (chiefly by the Ruthenians and Roumans), Roman Catholic (by the Magyars), Calvinist (by the Magyars), Lutheran (by the Saxons), and Unitarian (by the Szeklers). The Magyars and Saxons have the best schools; those belonging to some of the others are of a very inferior character. The first Transylvanian university was opened at Klausenburg in 1872. The Szeklers, or properly Székelys, who are believed by some to be descendants of the Huns, and by others of the Petchenegs and other tribes kindred to the Magyars, use a dialect little different from the language of the latter, this being also spoken by the Bulgarians and Armenians. The Saxons are descendants of German settlers from Flanders, the lower Rhine, the Hartz, and Thuringia, who established themselves in Transylvania especially about the middle of the 12th century, where they are unmixed with other races, and speak their own language, the German. They formerly enjoyed various privileges, based chiefly on a charter granted them by King Andrew II. in 1224, and more equality of rights than the other races. Together with the Magyars and Szeklers they formed the constitutionally ruling people, but now all nationalities enjoy equal rights. The country is therefore divided into the lands of the Hungarians (chiefly in the northwest and west), of the Szeklers (in the east), and of the Saxons (in the south and northeast). The land of the Hungarians is subdivided into the counties or comitats (*megyék*) of Klausenburg (*Kolozs*), Doboka, Inner Szolnok, Thorda, Kokelburg (*Küküllö*), Upper Weissenburg (*Fejérvár*), Lower Weissenburg, and Hunyad, and the districts of Fogaras and Nászod; the land of the Szeklers into the seats (*székek*) of Aranyos, Maros, Udvarhely, Csik, and Három-Szék; and the land of the Saxons into the seats (*Stühle*) of Hermannstadt, Broos, Mühlenbach, Reissmarkt, Mediasch, Schässburg, Gross-Schenk, Leschkirch, and Reps, and the districts of Kronstadt and Bistritz. Besides the capital, the most important towns are Hermannstadt, Kronstadt, Vásárhely-on-the-Maros, Bistritz, and the fortress Carlsburg. The constitution of Transylvania before the revolution of 1848–'9, during which it was reunited with Hungary, resembled that of the latter country, but was more complicated, owing to numerous reserved privileges. It was abolished by the Austrians in 1849, and restored in 1861, though not in its full vigor. In 1867 Transylvania was again fully united with Hungary, and its separate diet abolished.—Transylvania in the time of the Roman empire belonged to Dacia, was subsequently overrun by the Huns, Goths, Gepidæ, Lombards, Bulga-

rians, Avars, Petchenegs, and other tribes, and in the 10th and 11th centuries conquered by the Hungarians, who ruled it by waywodes, for a time disputing its possession with the Cumans. Having shared the fate of Hungary for centuries, it became an independent principality during the Turkish-Austrian wars in the early part of the 16th century, and was ruled among others by the Zápolyas, the Báthoris, Bocskay, Bethlen, the Rákóczys, and the Apafis, until it was finally annexed to Austria in 1713. (See HUNGARY, vol. ix., pp. 57–61, BÁTHORI, BETHLEN, RÁKÓCZY, and ZÁPOLYA.) The antagonism between the Roumans and Magyars, which in 1848 led to a bloody rising of the former, has not entirely subsided, and more or less secret agitations in favor of a union of Transylvania with Roumania, the united countries to form a strong Dacian realm, not unfrequently alarm the Hungarian government. The Saxons, too, hold themselves in opposition to the leadership of the Hungarians. On the E. and S. frontiers the people down to a late date held their land under the tenure of protecting the country against foreign aggression in these directions, the hardy and warlike Szeklers in the east constituting the principal strength of this military frontier organization.—See "Transylvania, its Products and its People," by Charles Boner (London, 1865), and *Voyage aux régions minières de la Transylvanie occidentale*, by Élisée Reclus (Paris, 1873).

**TRANSYLVANIA**, a S. W. county of North Carolina, bordering on South Carolina; area, about 475 sq. m.; pop. in 1870, 3,536, of whom 309 were colored. It contains the sources of the French Broad river, and is almost entirely surrounded and occupied by mountains. The soil of the valleys is fertile and well adapted to stock raising. The chief productions in 1870 were 12,476 bushels of rye, 95,633 of Indian corn, 8,142 of Irish and 3,101 of sweet potatoes, 18,844 lbs. of wool, 6,301 of tobacco, and 24,129 of butter. There were 504 horses, 1,197 milch cows, 2,712 other cattle, 4,721 sheep, and 6,490 swine. Capital, Brevard.

**TRANSYLVANIA UNIVERSITY.** See LEXINGTON, Ky.

**TRAP** (Swed. *trappa*, a stair), a class of volcanic rocks, so named because of the stair-like appearance they often present. There are several kinds of trap rocks, distinguished by their chemical composition and physical character. They are composed mainly of feldspar and hornblende, in varying proportions and states of aggregation, with sometimes augite, chrysolite, and other minerals in smaller quantities. The most important among the trap rocks are the basalts, amygdaloids, greenstones, and dolerites. They are therefore chiefly divided into felstone traps and hornblende traps, the principal variety of the latter being greenstone. Hypersthene rock is made up of Labrador feldspar and hypersthene, a variety of hornblende; it is abundant in the isle of Skye.

**TRAPANI. I.** A province of Sicily, comprising the W. extremity of the island, bounded E. by Palermo and Girgenti, and on the other sides by the Mediterranean; area, 1,214 sq. m.; pop. in 1872, 236,388. The coast line is irregular, and there are several bays, the largest of which is the gulf of Castellamare. The most important of the numerous islands off the W. coast are the three anciently called the Ægates, viz., Favignana, Levanzo, and Maritimo. The surface of Trapani is traversed by several offsets from the Madonian mountains. The soil is generally fertile. **II.** A city (anc. *Drepanum* or *Drepana*), capital of the province, on a peninsula which extends into the Mediterranean, 46 m. W. S. W. of Palermo; pop. in 1872, 33,634. It has a small harbor protected by a fort. The churches are exceedingly numerous, and there is a lyceum, a gymnasium, and an archæological museum endowed in 1875 by Cavaliere Depoli. The salt works and fisheries are of some importance.—Drepanum was founded by Hamilcar during the first Punic war, about 260 B. C., who transferred hither the inhabitants of the neighboring Eryx; and it remained one of the chief strongholds of the Carthaginians throughout this war. Off its port they gained a great naval victory under Adherbal in 249, destroying nearly the whole Roman fleet; and it was in attempting to raise its siege by the Roman consul Catulus in 241, that their ships under Hanno suffered off the island of Favignana (anc. *Ægusa*) the defeat which ended the war.

**TRAPEZUS.** See TREBIZOND.

**TRAPPISTS**, a branch of the Cistercian order famed for the austere reform inaugurated by De Rancé, abbot of La Trappe. (See RANCÉ.) This monastery is near Mortagne, in the French department of Orne. It was founded in 1140 by Rotrou II., count of Perche, who gave it to a colony of Benedictine monks from Savigny. In 1148 St. Bernard affiliated it to Clairvaux, and its inmates became famous for piety. During the incessant wars between the French and the English, the monks were frequently plundered and dispersed, till toward the close of the 15th century their long enforced absence from the monastery gradually weakened the habits of regular observance, and reduced their numbers to less than 20. Francis I. gave the ruined abbey *in commendam* to Cardinal du Bellay; and thenceforward all religious fervor and discipline were at an end. In the beginning of the reign of Louis XIV. only seven monks remained, whose licentious habits caused them to be called "the brigands of La Trappe." On July 13, 1664, De Rancé was consecrated abbot of La Trappe in the cathedral of Séez, by Oliver Plunket, archbishop of Armagh. The old monks who did not wish to adopt the severe life inaugurated by the abbot were allowed to depart, and were pensioned out of De Rancé's patrimony; and, after much opposition from the other Cistercian monasteries, and six years

of patient waiting, the mild firmness of the reformer and his exemplary life attracted a small number of followers. The chief centre of the reform, after La Trappe, was the Cistercian monastery of Tamié, near Faverges, in Upper Savoy. It adopted De Rancé's rule in 1677, was suppressed during the French revolution, and, after various vicissitudes, was again taken possession of, Oct. 15, 1861, by a colony of Trappists from Grâce-Dieu, near Besançon. The reform was approved by Innocent XI., but under certain restrictions. The monastic rule is noted for its severity. The members rise in the morning at 2 o'clock, and devote 12 hours a day to devotional exercises, and several hours to hard labor, mostly in the field. No worldly conversation is allowed; when meeting, they salute each other with the solemn *Memento mori* ("Remember death"). Their scanty food consists of water and vegetables; meat, wine, and beer are entirely forbidden. They sleep on a board, with a pillow of straw; and they never undress, not even in case of sickness. Hospitality is earnestly recommended; but it is also enjoined on the members to observe, in the exercise of hospitality, as much as possible the customary silence of the order and the simplicity of its mode of life. In 1789 the Trappists possessed, besides La Trappe and Tamié, only one monastery in Tuscany and one in western Germany. When they were suppressed in France, Dom Augustin Lestrange, who is regarded as the second founder of the order, opened an establishment at Fribourg in Switzerland, to which some of the monks repaired. The members of the other extinguished monasteries wandered through Europe for about 20 years, without finding a permanent abode. In 1817 the French government authorized the reopening of La Trappe, and the order soon counted several flourishing establishments. It was especially prosperous under the administration of the superior general Geramb (after 1825), one of the few Trappists who have won a reputation for authorship. In 1828, and again in 1830, the suppression of all the French establishments of the order was decreed by the government, but in neither case was the decree executed. Since 1870 the Trappists have ceased to exist legally in Italy and Switzerland, and in 1874 they were suppressed in the German empire. In 1803 a colony of Trappists led by Lestrange himself settled at Pigeon Hill, near Conewago, Pa.; in the autumn of 1805 they removed to Kentucky, thence to Florissant near St. Louis in 1808, and in 1809 to a farm 6 m. N. on the Illinois shore of the Mississippi. In 1813 they went to Tracadie in Nova Scotia, where they still exist. In 1848 Trappists from La Meilleraye in France settled at Gethsemane, Ky., 14 m. S. E. of Bardstown; a second establishment (now New Melleray abbey) has since been founded in Iowa, 12 m. from Dubuque. Both of these have been raised to the rank of abbeys, the abbots wearing the mitre.—An offshoot of the order of Trappists is the congregation of "Trappist Preachers," founded about 1845 by the abbé Muard, at Avallon, France, which connects home missionary labors with the observance of a Trappist mode of life.—The first convent of Trappist nuns was founded in 1692 in France.

**TRAS OS MONTES,** a N. E. province of Portugal, bordering on Spain and the provinces of Beira and Minho; area, 4,289 sq. m.; pop. in 1871, 365,833. It is the most mountainous part of the kingdom. The Douro constitutes its S. E. and S. boundary, and it is watered by its affluents the Sabor, Tua, and Tamega. It is now divided into the two districts of Villareal and Bragança. Capital, Bragança.

**TRASS.** See POZZUOLANA.

**TRAVANCORE,** a subsidiary native state of British India, occupying the S. W. extremity of the great Indian peninsula, terminating on the south in Cape Comorin, and bounded N. by the native state of Cochin and the district of Coimbatore in Madras, E. by the Madras districts of Madura and Tinnevelli, and S. and W. by the Indian ocean; area, 6,653 sq. m.; pop. about 1,400,000. The capital is Trivandrum, on a small river in the S. part of the state, about a mile and a half from the sea; other important towns are Aleppi, Quilon, and Anjengo, all on the coast. The surface slopes seaward from the Western Ghauts, which form its E. boundary, and at the N. E. corner reach an altitude of upward of 8,000 ft.; and the country is generally hilly, elevated, and well wooded, except on the coast. A large portion of the coast is low and sandy and fringed with cocoanut palms, but in the south the heights approach the sea and form a bolder shore. There is a good roadstead at Aleppi, and since 1871 Kolachul, near Cape Comorin, has been used as a port by the coffee planters, whose large ships have there found safe anchorage in still water. Travancore is drained by numerous westward-flowing streams, whose waters form extensive shallow lagoons or backwaters parallel with the coast. The largest river is the Perryaur, in the north, about 140 m. long, which is known as the Alwye near the sea. The rainfall of the western half of the country exceeds 100 inches per annum, but it is not more than 52 inches among the mountains or at Cape Comorin. The climate is hot but not unhealthful; at the capital the temperature rarely exceeds 90° at any time, or 75° during the S. W. monsoon, when the most rain falls. The soil is nearly everywhere productive, and very rich in the lowlands, where excellent rice is raised. The most valuable crops are coffee, which is very successfully cultivated in the hills, cocoanuts, areca nuts, and pepper, all of which are largely exported; ginger, cinnamon, nutmegs, indigo, and cardamoms are also grown. The forests furnish timber for export in great abundance and variety. Cinchona plantations have been established under government auspices. The

fauna of Travancore corresponds closely with that of Malabar. The mineral resources are as yet undeveloped; but salt is made, and there are known to be deposits of iron. There are but few manufactures.—Travancore is a Hindoo principality, and Hindoos constitute the largest and most influential part of the population, but the aboriginal element has been largely won over to Christianity. This element is most prominently represented by the Shannar tribe, among whom three English missionary societies have labored for many years, until as many as 90,000 of them are Christians living in Tinnevelli and Travancore. In North Travancore there are said to be 250,000 Roman Catholic converts, under one of the vicariates of southern India which originated in the Madura mission. There is a college of high standing at Trivandrum, affiliated with the Madras university, to which it sent 28 students in 1871. In 1872-'3 there were 16 other schools, at which English was taught to 808 pupils, 29 vernacular schools, and 138 village schools. The rajah maintains an astronomical observatory under the direction of a European astronomer. Many excellent roads and other public works have been constructed, and Travancore is one of the best governed and most prosperous native states in India. In 1872-'3 the total revenue of the government was £957,577, including £165,992 proceeds of the land tax and £130,421 from customs, while the total expenditure was but £549,365.—About the middle of the 18th century the many chieftains under whom Travancore was formerly parcelled out were subjugated by an ancestor of the present rajah, who ruled till 1799, and who adhered to the British in the war with Tippoo Sultan. In 1795 he entered into a subsidiary alliance with the Bombay government. The subsidy has been increased to £80,000 per annum, and the state is now supervised through the government of Madras. According to the fundamental Hindoo law of Travancore, the succession to the throne descends only through the female line. The sister of the present rajah, Rama Wurma, died in 1857, and as it was apparent that the line would otherwise become extinct, the British authorities guaranteed him the right of adoption.

**TRAVERSE,** a W. county of Minnesota, separated from Dakota by the Bois de Sioux or Sioux Wood river and Lake Traverse; area, about 575 sq. m.; pop. in 1870, 13. It is drained by Mustinka river and other affluents of Lake Traverse. The surface consists chiefly of rolling prairies. The St. Paul and Pacific railroad crosses the N. E. corner.

**TRAVIS,** a central county of Texas, intersected by the Colorado river; area, about 1,000 sq. m.; pop. in 1870, 13,153, of whom 4,647 were colored. The surface is moderately hilly, and the soil very fertile. There is considerable timber. Steamboats ascend the river to Austin, which is also the terminus of a branch of the Houston and Texas Central railroad. The chief productions in 1870 were 498,710 bushels of Indian corn, 88,210 of sweet potatoes, 56,792 lbs. of butter, and 16,769 bales of cotton. There were 6,584 horses, 1,337 mules and asses, 8,952 milch cows, 8,991 working oxen, 30,765 other cattle, 12,013 sheep, and 25,854 swine; 6 manufactories of carriages, 8 of saddlery and harness, 1 of bricks, 2 breweries, and 2 saw mills. Capital, Austin, which is also the capital of the state.

**TREADWELL, Daniel,** an American inventor, born in Ipswich, Mass., in 1791, died in Cambridge, Feb. 27, 1872. While still young he invented a machine for making wood screws. In 1818 he produced a printing press of a new construction, and went to England in 1819. He there conceived the construction of a power press, which was completed the year after his return, and was widely used. In 1822, in connection with Dr. John Ware, he established and conducted the "Boston Journal of Philosophy and the Arts." In 1826 he devised the system of turnouts upon single-track railroads. In 1829 he completed the first successful machine for spinning hemp for cordage. Works capable of spinning 1,000 tons in a year were erected in Boston in 1831; and in 1836 he furnished to the Charlestown navy yard machines for spinning the hemp and cordage for the navy. His circular hackle or lapper has been generally adopted in spinning hemp for coarse cloth. In 1834 he became Rumford professor of technology in Harvard college, and held this post till 1845. He devised a method of making cannon of wrought iron and steel, and executed a contract with the government for 12 six-pounders. But his first plan being found too expensive, he improved and simplified it, and described his new method in a memoir before the American academy in 1835. He secured his invention by patent in the United States and in England, and published an account of it in 1856. It is certain that 18 years before the Armstrong gun was produced in England Treadwell had made his; and that some years after his English patent had been published Sir William Armstrong produced his gun, formed upon the same plan, and adding thereto rifling and breech loading.

**TREASON,** in general terms, any act of hostility against a state, committed by one who owes allegiance to it. There is one important difference in what may be called the form or manifestation of this crime, which seems to constitute a difference in its essence, and has led to some confusion of thought as to the crime itself, and as to the laws or proceedings for its prevention. This difference is between the crime as it may be committed against a monarch or against a republic. Where the power and majesty of a state are embodied in a personal sovereign, there treason against him is treason against the state; but where the state is not thus impersonated, the treason must be against the state itself, and cannot be committed against any person. The *crimen*

*læsæ majestatis*, in all the ages of republican Rome, was regarded as a crime against the state, and not against its magistrates, excepting as they represented the state. The simple word *majestas* was often used as meaning this offence, although the whole expression of it was: *crimen læsæ, imminutæ, diminutæ*, or *minutæ majestatis*. At a later period, when the emperors, having first accumulated in their persons the higher magistracies of the republic, gradually and yet rapidly became despotic and irresponsible while the language of the law remained almost unchanged for a considerable time, the crime itself came to be regarded as primarily a crime against the personal sovereign, and derivatively against the state. In Rome, as afterward in England, the power of the sovereigns to enlarge the scope of this crime, and accuse whom they would of it, was enormously abused. But in both of these states it always remained, and in all civilized countries it must always remain, the highest of crimes, and more deserving of the severest punishment than any other; and for these reasons it needs to be most carefully limited, and to be guarded not only as to its extent, but as to the proof by which it may be established. The constitution of the United States (art. iii., sec. 3) declares that "treason against the United States shall consist only in levying war against them, or in adhering to their enemies, giving them aid and comfort." This cannot be regarded as a definition of treason so much as a limitation of it, and a declaration of what portion of the offences which had been at different times included within its meaning should be regarded as so included by our law. The word treason is used as a customary law term of well known significance; and indeed, in the most important cases which have arisen in the United States, it would seem that this provision of the constitution has but exchanged the burden of defining treason for that of defining the levying war against a state and adhering to its enemies.—In order to show the true meaning of the word treason, we must go back to the Roman civil law, which on this point had an important influence on the English law. In the early days of Rome, the word *perduellio* (from *perduellis*, which is defined by Gaius as *hostis*) was used almost as a synonyme of *majestas*, and indicates the idea of hostility to the state as belonging to it. Although commonly spoken of as the equivalent of treason, *majestas* certainly had a wider extent of meaning and operation than treason ever had in its extremest abuse in England. Cicero says (using the word *majestas* here in its original sense): *Majestas est in imperii atque in nominis populi Romani dignitate.* Elsewhere, for the purpose of defining the criminal offence of *læsa majestas*, he says: *Majestatem minuere est de dignitate, aut amplitudine, aut potestate populi, aut eorum quibus populus potestatem dedit aliquid derogare;* and in this wide sense *majestas* was applied to any maladministration in office of any magistrate. It became afterward much more like treason as it was in the worst periods of English history; and the abuse of it may be illustrated by some of the provisions of imperial law about the statues of the emperors. By some of these it was declared that to repair their statues when going to decay, or to injure one accidentally and unintentionally, or even to sell one if it had not been consecrated, was not a crime against the majesty of the state; but to melt one down after it had been consecrated constituted this offence. The earliest punishment of the crime was perpetual interdiction from fire and water; the later, death, to persons of low condition by wild beasts or burning, to those of higher rank by the ordinary method of execution.—We find treason recognized and punished as a crime from the beginning of the common law; and always the cause of the crime was some act of hostility against the government by one who owed to it allegiance. But during many ages the criminal law of England was unwritten, and lay in the determinations of judges who were removable at the king's pleasure, and who were often so corrupt that public justice was perverted into an instrument of remorseless tyranny. In the reign of Edward IV. an unfortunate punster, who kept an inn in London with the sign of the crown, said he would make his son heir of the crown; and for this offence he was hanged, drawn, and quartered. In the same reign an owner of deer, one of which was killed by the king while hunting, said he wished the horns of the deer were in the king's stomach; and for this he was put to death. But at a later period, when Russell and Sidney were slain through the instrumentality of a judicial trial for treason, this atrocious wickedness assumes at least a more dignified appearance. Indeed, during the whole of English history until the times of Cromwell, treason always had, in a greater or less degree, the character of a political offence. At many periods the leading men of the age fell victims to it. Hence has arisen a feeling of compassion for the sufferers, and of doubt as to their guilt, which has had an important influence on the public estimation of the crime in that country, and to some extent in this. Another reason for some laxity of thought and feeling concerning this crime, is the extreme uncertainty of the earlier law as to its definition and limits. Thus, Glanvil expressly identifies it with the *crimen læsæ majestatis;* Bracton includes within it the counterfeiting not merely of the king's seal, but of the king's money; and by a very current phrase it was supposed to embrace all "encroaching of (encroachment upon) royal power." So early as the 25th year of Edward III. an attempt was made to remedy this uncertainty by a statute defining treason, which was for the time an excellent law, although quite too wide in its scope. Among the principal offences here called treason were compassing the death of

the king, queen, or prince, or levying war against the king, or adhering to the king's enemies; but all these offences were to be proved by some overt act. In some of the subsequent reigns this excellent provision was evaded by construction, or the statute was disregarded, or new ones made. Thus, by the 32d of Henry VIII. it was made high treason to accept, take, judge, or believe the king's marriage with Anne of Cleves as legal and valid. But the leading provisions of the statute of Edward III. are still the law of England, and the reasonable construction of its language by the courts of England has been generally followed by the courts of the United States in construing the provisions of our own constitutions and laws. By the 1st of Edward VI. the provision was introduced which we have copied, requiring, for the conviction of one charged with treason, two sufficient and lawful witnesses; but this provision was in many instances shamefully perverted. Thus when only one living witness could be found who would testify to Algernon Sidney's treason, Jeffreys decided that garbled extracts from his writings might be read as the other witness, and on this testimony he was convicted and executed; and no greater dishonor rests on the name of Bacon than that he assisted his master, King James, in corrupting the judges of the king's bench into a willingness to convict of treason one Peacham, a parish priest, on the evidence of a sermon which he had never delivered, and which was found by searching his study. Out of the many civil conflicts and commotions in England, and especially the wars of the roses, grew one rule, still in force, and resting on the soundest justice and reason. During those ages of constant disturbance, when there were frequently more persons than one who claimed the crown, and, so far as they could, exercised royal authority, almost every person incurred the danger of treason, in case the claimant to whom he adhered was defeated; and for this cause, or on this pretence, multitudes of men of every rank perished on the scaffold. But from the obvious absurdity of exacting from every individual a sound, or rather a fortunate judgment as to the obscure and complicated grounds on which the claim to sovereignty often rested, it became and still remains a well settled rule, that no one incurs the guilt of treason by adherence to a king or government *de facto*, although that king or government has but the right of a successful rebel, and loses it all by a subsequent defeat.—In considering the crime of treason in the United States, we must remember that there may be treason against the United States, and also treason against any one of the states. Looking first to treason against the United States, the foundation of the law itself, and of our knowledge of it, must be the clause in the constitution already quoted; and as there is no common law of the United States, this clause would have remained inoperative but for the act of congress of 1790, chap. 36, sec. 1, whereby it was enacted, "that if any person or persons owing allegiance to the United States of America shall levy war against them, or shall adhere to their enemies, giving them aid and comfort within the United States or elsewhere, and shall be thereof convicted, on confession in open court, or on the testimony of two witnesses to the same overt act of the treason whereof he or they shall stand indicted, such person or persons shall stand adjudged guilty of treason against the United States, and shall suffer death." When the courts came to the construction and application of that act, they very properly made use of the principles and the jurisprudence of the common law; and they could do this the better, because the clause of the constitution is substantially the same as a provision of the statute of Edward III., and the best ability of England had been carefully employed about that statute. For a judicial exposition of that clause and that statute, we must look to the trial of Burr, and of Bollman and Swartwout (4 Cranch, pp. 75 to 137), although these are not the only cases in which the same subject has been considered.—The first question is: What is a levying of war against the United States, within the meaning of the statute? In the first place, the levying of war must be actual; it must be carried out into some practical operation and effect. No intention, and no extent or thoroughness of preparation or of conspiracy for war, constitutes the crime of treason until the war actually begins. Some kind of force or violence, it is said, must be used. But it would seem that this force may be what the law would call constructive force; and it may be very slight; for it certainly need not be sufficient to accomplish either the general purpose of the war, or the particular effect proposed. But, if there be any overt act of war, then every one aiding and abetting this act of war, however remotely, does himself levy war and commit treason. It must be difficult to determine always what this rule requires. Thus, Marshall declares that if an army be actually raised for the avowed purpose of carrying on war against the United States, and subverting their government, the point must be weighed very deliberately before a judge would venture to decide that an overt act of levying war had not been committed by a commissary or purchaser who never saw the army, but who, knowing its object and leaguing himself with the rebels, supplied that army with provisions; or by a recruiting officer, holding a commission in the rebel service, who, though never in camp, executed a particular duty required of him. Hence it would follow, that if there be an act of levying war against the United States, persons may be participators of that act, and of the crime which it constitutes, although they reside as far as possible from its actual locality. The prevailing rule of the criminal law, that there may be principals and accessories to a

crime, has no application whatever to treason. We are warranted by the language of Chief Justice Marshall in saying, that if a rebellion were so extensive as to spread through every state in the Union, every individual concerned in it is not legally present at every overt act committed in that rebellion; nor can it be said that even the commander-in-chief of the rebel army, or the head of the organized rebellion, is legally present at every such overt act. But while a man may be actually absent, yet if he have counselled or procured the treasonable act, he is a principal traitor, not because he is legally present, but because in treason all are principals. This question of locality has yet another importance. A person charged with this crime can be tried only within the state or judicial district in which it is committed, and the alleged criminal has indeed a strict right to be tried by a jury within that state or district. A wide extent may be given to this rule, by the doctrine that in treason all are principals, as above stated; but it can apply only to those persons who would, in the locality in which they reside, be either principals or accessories if there could be accessories to this crime. For if a person commits his own act of treason in a certain locality, and is not connected with any one committed elsewhere, so as to be, in this way, a principal in the act, he can be tried only within his locality; and if the judicial tribunals of the United States cannot or will not perform their proper functions within that state or judicial district, he cannot be tried anywhere. It is certain, too, that the overt act which is alleged to be a treasonable act, must have been done with "a treasonable purpose." We have on this point high authority for saying, that if the object of the act be to prevent by force the execution of any public law of the United States, that is a treasonable purpose, for it aims at overthrowing the government as to one of its laws. So, if the purpose be to overthrow the government at one place, large or small, that is a treasonable purpose.—What, then, is adhering to an enemy, or, in the language of the constitution, giving him aid and comfort? It is perhaps impossible so to define these words as to make their meaning any plainer. But, again on high authority, this meaning may be illustrated thus: If a conspiracy to levy war against the United States be in actual operation anywhere within it, any citizen, residing anywhere else and at whatever distance, if he supply the rebels with arms or any munitions of war, with provisions to be used in support of the war or of the rebels while carrying it on, or money, or intelligence or information, and even if none of these things reach the rebels, he becomes a traitor in the place where he resides. So it would come under this branch of treason, if forts, castles, or ships of war were delivered to the enemy, or if the accused had joined the enemy's forces, though no battles or conflicts take place. The same principles would undoubtedly apply, whether the treason charged were committed against the United States or against any one of the states, qualified only by any special provisions of the constitution or law of that state.—As all treason consists of hostility against a state by one who owes it allegiance, so only one who owes this duty, in some way, may be a traitor. But it is held that this modified allegiance may be that of an alien residing in this country and enjoying the protection and advantages of its government. The allegiance of an alien, however, or the possibility of his becoming a traitor, ends with his residence in this country; while the duty of allegiance goes with a citizen wherever he goes; and wherever he may be, he becomes a traitor by hostility against the government in violation of this duty.—We have seen that no one can be convicted of treason except on the evidence of two witnesses; but with this exception, the trial for treason is conducted in all respects like any other criminal trial for a capital offence. If convicted, the traitor may be sentenced to death by the ordinary means of execution; but by act of congress of July 17, 1862, the punishment in the discretion of the court may be imprisonment for not less than five years and a fine of not less than $10,000. We have no remnant of that ferocious cruelty which was considered necessary in barbarous ages, and in statutes often outlived them. Until the 30th year of George III. the convict of treason forfeited his property to the crown, was drawn on a hurdle to the gallows, there hanged, then cut down, disembowelled, and his entrails burned before life was extinct; and the body was then beheaded and quartered.

**TREASURE TROVE** (literally, found treasure), a term applied to money, coin, plate, or other forms of the precious metals, found hidden, for which no owner or depositor can be discovered. By the common law of England such property becomes vested in the sovereign, if it appears to have been concealed with the intention of reclaiming it. In all other cases, as where circumstances show that the treasure was intended to be abandoned, it belongs to the finder, who by a special order in council is also entitled to the commercial value of ancient coins and other objects of antiquarian interest, under whatever circumstances they may be found. The civil law formerly gave the treasure trove to the finder; or if found on another man's land, it was divided between them; but the practice in continental Europe has in modern times been similar to that in England.

**TREBBIA** (anc. *Trebia*), a small river of N. Italy, rising in the Ligurian Alps, about 15 m. N. E. of Genoa, and emptying into the Po 3 m. above Piacenza. On its banks the Romans under T. Sempronius were defeated by Hannibal in 218 B. C., and the French under Macdonald by Suvaroff, June 17-19, 1799.

**TREBIGNE**, or **Trebinie**, a town and formerly the capital of Herzegovina, European Turkey,

about 8 m. from the frontier of Montenegro, and 15 m. N. E. of Ragusa; pop. less than 5,000. A Roman Catholic bishop resides here, and there are several churches and mosques. It is defended by a square fort with four towers. Trebigne and its vicinity were the theatre of war with the Turks during the insurrection of 1875–'6. Under the early kings of Servia it was of much greater importance.

**TREBIZOND.** **I.** A vilayet of Asiatic Turkey, extending, in a generally narrow strip from 20 to 80 m. wide, about 360 m. along the S. coast of the Black sea, between lon. 35° 40′ and 42° E., bounded N. E. by the Russian division of Transcaucasia, E. by Erzerum, S. by Erzerum and Sivas, and W. by Kastamuni; area, about 15,000 sq. m.; pop. estimated at 940,000. The scenery on the coast is remarkably beautiful. The mountains rise immediately from the sea to the height of from 6,000 to 8,000 ft. in the east (in single peaks much higher), and nearly 5,000 ft. in the west, and are clothed with every variety of vegetation, from grass to dense forests. The country is generally well wooded and mountainous, and has but little arable land. The principal rivers are the Tchoruk, which enters the sea near the E. frontier, and the Yeshil Irmak and Kizil Irmak, the lower courses of which drain the W. part of the province. The climate is temperate but variable, being subject to cold winds from the Black sea, bearing rain and fog. The province is decidedly healthful. There are numerous fertile valleys and well cultivated tracts, but the country does not produce sufficient grain for home consumption. The inhabitants are described as bold and hardy. In many districts they are isolated cottagers, there being few villages. There are 56,000 Christians in the province, of whom two thirds belong to the Greek church, and the rest are Armenians. The chief towns, besides the

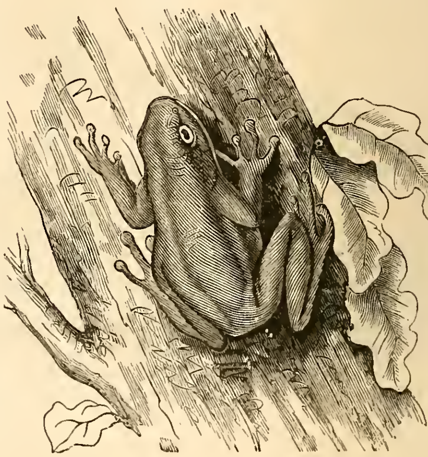
Trebizond.

capital, are Tireboli (anc. *Tripolis*), Keresun (*Cerasus*), Rizah (*Rhizus*), Batum (*Bathys*), and Samsun. The vilayet embraces the main parts of ancient Pontus, extending both E. and W. beyond its limits. **II.** A city (anc. *Trapezus*), capital of the vilayet, sometimes called Tarabazan, on the S. E. shore of the Black sea, in lat. 41° 1′ N., lon. 39° 45′ E., 560 m. due E. of Constantinople; pop. about 40,000. It is the first Turkish commercial port on the Black sea, and the entrepot of an extensive trade with the interior provinces and Persia. A peninsula separates the harbor into two ports, of which the eastern affords shelter and anchorage for the largest vessels. There is a lighthouse here and another at Platana, a roadstead about 6 m. W. of Trebizond. Four steamship lines connect the city with the principal ports of Turkey and southern Russia. Grain, from Russia and the Danube, is the chief article of import; the exports produced in the province itself include flax, nuts, butter, beans, linseed, fruits, tobacco, rice, wine, olive oil, fish oil, beeswax, and timber. The overland trade with Persia is valued at more than $6,500,000 per annum, and gives employment to 60,000 pack horses, 6,000 asses, 2,000 camels, and 3,000 oxen. Tobacco, silk, raisins, and carpets are exported from Persia for shipment at Trebizond, whence are imported cotton and woollen goods, tea, sugar, glass ware, hardware, and European manufactured goods of many kinds. The inland traffic with Anatolia, on the west, represents a value of more than $2,500,000; the exports through Trebizond comprising grain, potatoes, fruits, skins, wax, honey, and chestnuts. The city consists of an old and a new town, the former surrounded by walls and towers enclosing the citadel, which stands upon the flat top of a steep rock. The modern town is mainly without these walls on the E. side. Trebizond is well paved and drained, but the houses generally are neither commodious nor comfortable. There are 40 mosques, 18 Mohammedan schools, and 16 churches, of which 9 are Greek, 4 Armenian, 1 Catholic Armenian, 1 Latin, and 1 Presbyterian.—Trapezus was

founded by a colony from Sinope, and was a flourishing town when Xenophon arrived there on his retreat from Cunaxa. It became subject to the Romans by conquest from Mithridates. The emperor Trajan constructed a mole to improve the port, and made it the capital of eastern or Cappadocian Pontus. During the reign of Gallienus it was plundered and nearly destroyed by the Goths, but in the time of Justinian it had completely recovered, and was made the capital of a province which included Pontus and some part of Armenia. In 1204 it became the seat of an independent branch of the Comnenus family (see ALEXIS, and BYZANTINE EMPIRE), under whom the territory was called the empire of Trebizond. It continued subject to this line of rulers until it was conquered by the Turks in 1461.

**TREDGOLD, Thomas,** an English engineer, born at Brandon, near Durham, Aug. 22, 1788, died in London, Jan. 28, 1829. In 1808 he went to Scotland, where he worked five years as a journeyman carpenter and joiner, studying ardently in spare hours. In 1813 he went to London, and entered the service of William Atkinson, architect to the ordnance, and in 1823 commenced as civil engineer on his own account. He published "Elementary Principles of Carpentry" (4to, London, 1820); "A Practical Essay on the Strength of Cast Iron and other Metals" (8vo, 1821); "The Principles of Warming and Ventilating Public Buildings, Dwelling Houses," &c. (2d. ed., 1824); "A Practical Treatise on Railroads and Carriages" (1825); "Remarks on Steam Navigation, and its Protection, Regulation, and Encouragement" (1825); and "The Steam Engine, comprising an Account of its Invention and progressive Improvement, with an Investigation of its Principles" (4to, 1827), a later edition of which (1850–'53) is in 4 vols. 4to, with 226 steel plates and 164 woodcuts.

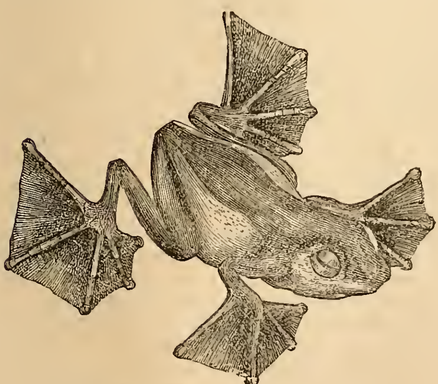
**TREE FROG,** the name of the batrachian reptiles of the family *hyladæ*, distinguished from common frogs (*ranidæ*) by having the ends of the fingers and toes dilated into flattened disks or suckers, which enable them to lead an arboreal life. They are more elegant, smaller, brighter, and more active than the *ranidæ*, and are lively during the day; they feed on insects; they climb like the geckos among lizards, and by the same mechanism; the lower surface of the disks is endued with a viscid secretion, by means of which they can walk with the body suspended from the under parts of leaves and other smooth bodies; the skin is mostly smooth upon the back, but on the abdomen and inside of legs thickly studded with small warts or tubercles. They possess to a remarkable degree the faculty of changing color, which enables them to elude their numerous enemies. They are very clamorous, and particularly noisy at the approach of rain; in winter they bury themselves in the mud at the bottom of pools; they breed in the spring, depositing their eggs in the water. They are frequently called tree toads, and their French name is *rainettes.* The species are numerous, especially in America; only one is found in Europe, and that also occurs in N. Africa and Asia.—The common tree frog of North America (*hyla versicolor*, Le Conte) resembles a toad in form, but is more flattened; body short and warty above, the color varying from pale ash to dark brown, with several large irregular blotches of greenish brown, white and granulated below, and abdomen yellowish near the thighs; the colors vary at the will of the animal. The head is short and rounded, the mouth large, with teeth on upper jaw and vomer; eyes large and brilliant, the iris bright golden; there are four fingers and five toes, both ending in viscous pellets, the former distinct, but the latter webbed for four fifths of their length. It is about 2 in. long, and is found abundantly in the northern and middle states, and as far west as the Mississippi; it is generally seen on



Common Tree Frog (Hyla versicolor).

decaying trees and about old fences of wood or stone, overgrown with mosses and lichens, the color of which it so nearly resembles that it is very difficult to detect; it is very noisy in spring and summer toward evening, especially in cloudy weather; the secretion of the skin is copious and very acrid. This species is replaced in the southern states by the green tree frog (*H. viridis*, Laur.; *calamita Carolinensis*, Penn.), which is bright green above, yellowish white below, with a straw-colored lateral line extending from the upper jaw over the shoulder and along the side. The tree frog of Europe (*H. arborea*, Linn.) much resembles the green species of North America, and the latter was considered by Laurenti a variety of his *H. viridis;* it is spread throughout Europe, except in Great Britain.—In the genus *acris* (Dum. and Bibr.) the locomotive disks are less developed and the limbs more slender than in *hyla*, and there are teeth on the palate instead of the

vomer. The *A. gryllus* (Dum. and Bibr.), or Savannah cricket, occurring from New England to the gulf of Mexico, is about 1½ in. long, with an elongated pointed head, a triangular dusky spot between the orbits; body ashy above, with a green and sometimes reddish dorsal line, and three oblong black spots margined with white on the sides. It may easily be domesticated; it makes immense leaps; it is intermediate between the *ranidæ* and *hyladæ*, having the aquatic habits of the former and the method of watching for its prey of the latter; in consequence of the smallness of the disks it cannot adhere to the under surface of smooth bodies.—The flying tree frog of Borneo (*rhacophorus*), according to Mr. Wallace, has its very long toes fully webbed to their extremity, so that by expanding these webs and inflating its body, it is able to use them as a parachute or sailing membrane in its descent



Flying Tree Frog of Borneo (Rhacophorus).

from high trees. The frog is 4 in. long, deep green above, yellow below; the webs of all the feet cover a surface of 12 sq. in.; at the ends of the toes are the usual disks for adhesion. This is the only aërial batrachian known.

**TREE SORREL,** or properly **Sorrel Tree,** a North American tree of the heath family (*ericaceæ*), formerly known as *Andromeda arborea;* when later botanists subdivided Linnæus's genus *Andromeda*, this was placed by itself in a new genus, *oxydendrum* (Gr. ὀξύς, sour, and δένδρον, a tree), a name which recognizes the marked acid character of the foliage; it is also known as sour-wood. The only species, *O. arboreum*, is found from Ohio and Pennsylvania southward, especially along the mountains, where it is met with as a large shrub, or in favorable locations it forms a tree 40 or even 60 ft. high. Its leaves are deciduous, serrulate on the margins, with slender petioles, and being pointed at each end they have much the appearance of those of the peach. The flowers, which appear in June and July, and even later, are in long one-sided racemes which are clustered at the ends of the branches; the corolla is ovate with five teeth, white, and in size and arrangement upon the stem bear some resemblance to those of the lily of the valley; after the flowers fall the small pyramidal pods remain white for a long time, and at a little distance appear like

Sorrel Tree (Oxydendrum arboreum).

flowers. The wood of the tree is of little value; the leaves are pleasantly sour, and are chewed by hunters to allay thirst. The tree is hardy north of its natural localities, and endures the climate of Boston. As an ornamental tree it possesses many merits, not the least of which is that of flowering when only a few feet high; when it is 10 or 15 ft. high it forms a spreading head, to which its fine spray gives a very light appearance, and when covered with its abundant clusters of delicate white flowers, it is a truly beautiful object; in autumn the foliage takes on a pleasing dark crimson color.

**TREFOIL.** See CLOVER.

**TREGELLES, Samuel Prideaux,** an English scholar, born in Falmouth, Jan. 30, 1813, died in Plymouth, April 24, 1875. His parents were Quakers, but he himself became connected with the Plymouth Brethren. He was educated at Falmouth grammar school, was employed in the iron works at Neath Abbey, Glamorganshire, and in 1836 became private tutor in Falmouth. He devoted himself to the study of the Scriptures in the originals and the old versions, especially the Syriac, and edited "The Englishman's Greek Concordance to the New Testament" (8vo, 1839); "The English Hexapla," with a historical account of the English versions of the Scriptures (1841); "The Englishman's Hebrew and Chaldee Concordance to the Old Testament" (2 vols., 1843); and "Hebrew Student's Manual," comprising Hebrew reading lessons, and the book of Psalms with interlinear translations (1845); and he translated, with additions and corrections, Gesenius's "Hebrew and Chaldee Lexicon to the Old Testament" (4to, 1847). Dr. Tregelles visited the continent several times for the purpose of collating the principal un-

cial manuscripts of the Scriptures in the libraries. At Rome he was allowed to see the Vatican manuscript, but was not permitted to collate it. His greatest work is "The Greek New Testament, edited from ancient Authorities, with the Various Readings of all the ancient Manuscripts, ancient Versions, and earlier Ecclesiastical Writers, together with the Latin Version of Jerome" (6 parts, 1857–'72). His other publications are: "The Book of Revelation, translated from the ancient Greek Text" (1848); "The Jansenists, their Rise, Persecution by the Jesuits, Existing Remnant," &c. (1851); "Defence of the Authenticity of the Book of Daniel" (1852); "Account of the Printed Text of the Greek Testament" (1854); *Codex Zacynthius*, a Greek palimpsest, containing portions of St. Luke's Gospel (1861); and *Canon Muratorianus*, the earliest catalogue of the books of the New Testament (4to, 1868). He contributed to Smith's "Dictionary of the Bible." He received the degree of LL. D. from St. Andrews university in 1850.

**TREGO,** a W. county of Kansas, intersected by the Saline and Smoky Hill rivers; area, 900 sq. m.; pop. in 1870, 166. It is traversed by the Kansas Pacific railroad. The surface is rolling and the soil rich. It is unorganized.

**TREMPEALEAU,** a W. county of Wisconsin, bounded S. W. by the Mississippi river, intersected by Trempealeau Mountain river, and drained also by Black and Buffalo rivers; area, 684 sq. m.; pop. in 1875, 14,992. The surface is level and the soil fertile. The chief productions in 1870 were 516,194 bushels of wheat, 141,275 of Indian corn, 241,408 of oats, 17,553 of barley, 47,699 of potatoes, 37,242 lbs. of wool, 341,043 of butter, and 18,794 tons of hay. There were 2,784 horses, 3,537 milch cows, 5,328 other cattle, 9,536 sheep, and 2,906 swine. Capital, Galesville.

**TRENCH, Richard Chenevix,** a British clergyman, born in Dublin, Sept. 9, 1807. He graduated at Cambridge in 1829, and after spending some years in travel took orders in 1833, and became curate to Hugh James Rose at Hadleigh, Suffolk, and in 1835 incumbent of Curdridge, a chapelry in the parish of Bishop's-Waltham, Hants. In 1840 he was appointed curate to Archdeacon Wilberforce at Alverstoke, near Gosport, and in 1844 rector of Itchenstoke. Dr. Wilberforce, being made bishop of Oxford in 1845, appointed Mr. Trench his examining chaplain. During this and the following year he was Hulsean lecturer at Cambridge. From 1846 to 1858 he was theological professor in King's college, London. In 1856 he was made dean of Westminster, and on Jan. 1, 1864, he succeeded Dr. Whately as archbishop of Dublin. He has published the following poetical works: "Justin Martyr, and other Poems" (London, 1835; 5th ed., 1862); "Sabbation, Honor Neale, and other Poems" (1838); "Poems from Eastern Sources," and "Genoveva" (1842; 2d ed., 1851); "Elegiac Poems" (1846); and "Alma" (1854). His theological publications include "Notes on the Parables" (1841; 11th ed., revised, 1870); "The Sermon on the Mount, illustrated from St. Augustine" (London, 1844; 3d ed., 1869); two volumes of Hulsean lectures, "The Fitness of Holy Scripture for unfolding the Spiritual Life of Men" (Cambridge, 1845), and "Christ the Desire of all Nations" (1846); "Notes on the Miracles" (1846; 9th ed., 1870); "Sacred Latin Poetry" (1849; new ed., 1864); "The Star of the Wise Men" (1850); "Sermons preached in Westminster Abbey" (1860); "Commentary on the Epistles to the Seven Churches in Asia" (1861; 3d ed., 1866); "Studies on the Gospels" (1867); "Shipwrecks of Faith," three sermons (1867); and "Sermons preached for the most part in Ireland" (1873). Among his philological works are: "The Study of Words" (1851; 15th ed., 1874); "The Lessons in Proverbs" (1853; 6th ed., 1869); "Synonymes of the New Testament" (1854; 2d series, 1863; 7th ed., enlarged, 1871); "English, Past and Present" (1855; 8th ed., 1870); "On some Deficiencies in our English Dictionaries" (1857); "On the Authorized Version of the New Testament" (1858); and "A select Glossary of English Words used formerly in Senses different from their present" (1859; 4th ed., 1865). He has also published "Calderon, his Life and Genius, with Specimens of his Plays" (8vo, 1856; 2d ed., 1865); "Gustavus Adolphus, with other Lectures on the Thirty Years' War" (1865; 2d ed., 1866); and "Plutarch, his Life, his Parallel Lives, and his Morals" (2d ed., 1874); and he has edited "The Remains of the late Mrs. Richard Trench," his mother (1862), and a "Household Book of English Poetry" (1868).

**TRENCK. I. Franz von der,** baron, an Austrian soldier, born in Reggio, Calabria, Jan. 1, 1711, died in prison at Brünn, Oct. 14, 1749. In his 17th year he entered the Austrian service, but was obliged to leave it on account of his insubordination and excesses. In 1738 he became captain in a Russian hussar regiment. He was twice condemned to death for violations of discipline, but was saved by Marshal Münnich, and after six months' penal labor retired to his estates in Slavonia. In 1740 he was permitted by the empress Maria Theresa to raise a corps of pandoors at his own expense, which soon numbered 5,000 men. At the head of these he served in the war of the Austrian succession, and distinguished himself by his courage, cruelty, and rapacity. Having at length, while undergoing trial by court martial, throttled one of the judges and attempted to throw him out of a high window, he was condemned to perpetual imprisonment in the castle of Spielberg at Brünn, where, according to some, he poisoned himself. He possessed astonishing physical strength, united with a disposition of extraordinary ferocity. His autobiography appeared at Vienna in 1807, under the title of *Merkwürdiges Leben und Thaten des Freiherrn Franz von der Trenck;*

and his life has been written by Hübner, under the title of *Franz von der Trenck, dargestellt von einem Unparteiischen, mit einer Vorrede von Schubart* (3 vols., Stuttgart, 1788). **II. Friedrich von der**, baron, a German adventurer, cousin of the preceding, born in Königsberg, Feb. 16, 1726, guillotined in Paris, July 25, 1794. He was admitted in 1742 into the body guard of Frederick the Great, and when only 18 years old was selected to instruct the Silesian cavalry. In the campaign of 1744 he served with distinction, acting as the adjutant of Frederick, with whom he became a favorite. In his memoirs he says he offended the king by an amour with the princess Amelia, but the story is apparently without foundation. In 1745 he again distinguished himself; but having corresponded with his cousin Baron Franz, then in the Austrian service, he was arrested and imprisoned in the fortress of Glatz for more than a year. After several desperate efforts he escaped and went to Vienna, where he got into much trouble and fought several duels. After the peace he was received with much favor at Moscow. His cousin left him his estate, on condition that he should become a Catholic and should serve only the house of Austria. To secure this he went to Vienna in 1750, but after three years of waiting he received only 63,000 florins. By the Austrian court he was made captain of cavalry. In March, 1754, he made a journey to Dantzic to settle some family affairs, and was there apprehended by the Prussian authorities, carried to Berlin and thence to Magdeburg, where he was confined in a dungeon in the citadel. He made several desperate efforts to escape, but failed in all of them, and after ten years' imprisonment, during which he was more and more heavily loaded with irons, he was finally released by order of Frederick in December, 1763, and carried to Prague. Disappointed of preferment at the Austrian court, he retired to Aix-la-Chapelle, married there in 1765, and lived for several years in peace, occupying himself with literary pursuits. In 1767 appeared his poem *Der macedonische Held*, which gave him considerable reputation in Germany. He also engaged in the wine trade. From 1774 to 1777 his time was spent chiefly in travelling through England and France. Subsequently he retired to his estate at Zwerbach, spent several years in agricultural pursuits, and published a collection of his works and a history of his life. After the death of Frederick in 1786 the confiscation of his estates was annulled, and he was permitted to return to his native country. During the French revolution he went to Paris, where he was arrested by the committee of public safety and put to death on the charge of being a secret emissary of the king of Prussia. His autobiography is very interesting, and has still considerable circulation, though it is certain that Trenck was a braggart and a liar, and has immensely exaggerated his adventures.

**TRENDELENBURG, Friedrich Adolf**, a German philosopher, born at Eutin, near Lübeck, Nov. 30, 1802, died in Berlin, Jan. 24, 1872. In 1826 he graduated in Berlin, where he was private tutor till 1833, and subsequently professor at the university, of which he was three times rector. He was also for over 20 years secretary to the historico-philosophical section of the Berlin academy. He was a follower of Aristotle and an opponent of Hegel. His works include *Elementa Logices Aristotelicæ* (Berlin, 1837; 6th ed., 1868); *Logische Untersuchungen* (1840; 3d ed., 1870); *Geschichte der Kategorienlehre* (1846); *Historische Beiträge zur Philosophie* (2d and 3d vols., 1856-'67); *Naturrecht auf dem Grunde der Ethik* (1860; 2d ed., 1868); *Lücken im Völkerrecht* (1870); *Kuno Fischer und sein Kant* (1869), which led to Fischer's *Anti-Trendelenburg* (1870); and *Kleine Schriften* (2 vols., 1871).—See Bonitz, *Zur Erinnerung an Friedrich Adolf Trendelenburg* (Berlin, 1872).

**TRENT**, a river of England, which rises in Staffordshire, 4 m. N. of Burslem, flows through the central part of the country, and near Burton-on-Strather, Lincolnshire, joins the Ouse to form the estuary called the Humber. Its course is first S. E., then N. E., and finally N. Its total length is about 150 m., of which 25 m., as far as Gainsborough, is navigable for vessels of 200 tons, and 117 m., reaching to Burton-on-Trent, for barges of 25 tons. Its chief tributaries on the right are the Sow, Tame, Soar, and Devon, and on the left the Blyth, Dove, and Derwent; and it is connected with other navigable waters by canals. Stoke and Nottingham are situated on its banks.

**TRENT** (Ital. *Trento;* Ger. *Trient;* anc. *Tridentum*), a city of Tyrol, Austria, on the left bank of the Adige, 83 m. S. by W. of Innspruck; pop. in 1870, 17,073. It is in a beautiful valley, surrounded on the east by mountains, and is Italian in its architecture. It has a cathedral built entirely of marble in the Byzantine style. In the church of Sta. Maria Maggiore, of red marble, are the portraits of the members of the council of Trent, which was held in that building. The extensive castle is generally the residence of the local prince-bishop. Silk is the principal manufacture; wine is largely produced; and there is an active transit trade.—The ancient Tridentum was a town of the Rhætians, and subsequently became a Roman colony. Under the old German empire it was a free imperial city, ruled by prince-bishops. In 1802 it passed under the domination of Austria.

**TRENT, Council of** (*concilium Tridentinum*), the 19th œcumenical council, according to the Roman Catholic church. The first occasion for an œcumenical council in the 16th century was furnished by Luther, who on Nov. 28, 1518, appealed from the bull of Leo X. to a general council, and was supported by the Protestant princes. The Catholic sovereigns also desired that a council should be convened.

Three popes, Leo X., Adrian VI., and Clement VII., died before the demands of the Germans were complied with. At length Paul III., after failing in attempts (1536–'8) to convene a council at Mantua, and next at Vicenza, convoked it for Nov. 1, 1542, to assemble at Trent; but on account of the war between the emperor Charles V. and Francis I. of France he again put off the day of opening to March 15, 1545, and the actual opening did not take place until Dec. 13, 1545. The objects of the council were to effect a reformation of the church, to define more explicitly the impugned doctrines of the church, and, if possible, to induce the Protestants to return to the old faith. At the second session (Jan. 7, 1546) the council fixed the mode of transacting business. The discussions and deliberations were to take place in private congregations; subsequently general congregations were to draft the resolutions, which finally were to be promulgated in public sessions as decrees. In the third session (Feb. 4) the Nicene creed was read and declared to be the basis of the further proceedings. In the fourth session (April 8) tradition was declared to be equally with the Bible a rule of faith; the Apocrypha of the Old Testament were included in the Biblical canon; the Vulgate was proclaimed to be the authentic version of the Bible, and the church its only legitimate interpreter. In the three following sessions (June 17, 1546; Jan. 13 and March 3, 1547), the Catholic doctrines of original sin, justification, and the sacraments were defined, and an anathema pronounced upon all who rejected these doctrines. In the eighth session (March 11), 38 of the 56 bishops present, together with the papal legate, determined, on the ground of being exposed at Trent to the plague, to adjourn to Bologna, notwithstanding the decided opposition of the emperor, at whose request 18 German and Spanish bishops remained at Trent. At Bologna, where 6 archbishops, 32 bishops, and 4 generals of religious orders were present, the 9th and 10th sessions were held (April 21 and June 2); but, at the express order of the pope, who had some apprehensions of a schism, no decrees were promulgated, except decrees of prorogation. As Charles V. could not be prevailed upon to recognize the council of Bologna, the council was indefinitely prorogued by a bull of Pope Paul III., dated Sept. 17, 1549. The pope died in November, 1549, and on May 1, 1551, the council was reopened at Trent by order of Julius III. France protested against the continuation, and all the French bishops and theologians withdrew. In the succeeding transactions the Jesuits Laynez and Salmeron, who were sent to the council as papal theologians, took a leading part. There appeared also representatives from the Protestant princes of Würtemberg and Brandenburg, and even Melanchthon was summoned there by order of the elector Maurice of Saxony; but it was found impossible to effect a reunion, and soon the outbreak of a new war of the Protestant princes against the emperor caused the assembled fathers (April 28, 1552) to suspend their deliberations. During this period, extending from the 11th to the 16th session, the doctrines of the eucharist, confession, and extreme unction, and two reformatory decrees on the jurisdiction of the bishops, were promulgated. Paul IV. was anxious to assemble the council at Rome, but Pius IV. consented to its reopening at Trent, which took place on Jan. 18, 1562, through the cardinal legate Prince Ercole Gonzaga of Mantua. The representatives of Charles IX. of France and the emperor Ferdinand I. wished to conciliate the Protestants by granting the cup to the laity, and the duke of Bavaria demanded the abolition of celibacy. The former question was referred to the pope; the latter was unanimously rejected. On Nov. 13 the cardinal of Lorraine arrived, with 14 bishops, 3 abbots, and 18 theologians from France, and presented in the name of his nation 34 reformatory articles, but subsequently abandoned their advocacy. On the question whether episcopal jurisdiction proceeds immediately from Christ, or mediately only and through the pope, no decree was arrived at; it being simply declared that "bishops are established by the Holy Ghost, to rule the church of God." Decrees were adopted ordering an index of prohibited books to be made, and defining the doctrines of the mass, ordination, the hierarchy, marriage, celibacy, purgatory, the veneration of saints, relics, and images, monastic vows, indulgences, and fasting and abstinence. Several "reformatory" decrees were also passed, the most important of which enjoined the establishment of theological seminaries. The close of the council was hastened by a serious sickness of the pope, and his fear that his death might lead to a schism. It took place on Dec. 4, 1563, at its 25th public session. The decrees were signed by 255 members, consisting of 4 legates, 2 other cardinals, 3 patriarchs, 25 archbishops, 168 bishops, 39 representatives of absent bishops, 7 abbots, and 7 generals of religious orders. An authentic copy was also signed by the ambassadors of the secular governments, with the exception of the ambassador of Spain, who was without instruction, and the ambassador of France, who was absent. The decrees were confirmed by the pope, with the unanimous consent of the cardinals, in the consistory of Jan. 26, 1564; but the pope reserved to himself the right of explaining obscure or controverted points. The council was accepted unconditionally by most of the Italian states, by Portugal, Poland, and the German emperor; with a reservation of the royal prerogatives by Spain, Naples, and the Netherlands; with some exceptions by Switzerland and Hungary; and only so far as respects doctrines by France.—The "Canons and Decrees" of the council were printed by Aldus Manutius (Rome, 1564). The "Catechism," an authorized summary of the faith drawn up

by order of the council, appeared at Rome in 1566, and the collection of documents relating to its history was edited by Le Plat (7 vols. 4to, Louvain, 1781). The first complete history of the council was written by Paolo Sarpi (London, 1619; English translation by Brent, London, 1676), in a spirit of decided opposition to the papal court. Against him wrote Cardinal Sforza-Pallavicino (2 vols., Rome, 1656–'7). A work on the discrepancies of both has been published by Dr. Brischar (2 vols., Tübingen, 1843). Mendham's "Memoirs of the Council of Trent" (London, 1834) contains extracts from 28 volumes of manuscripts collected in Italy by Lord Guilford. See also Waterworth's history of the council prefixed to his translation of its canons and decrees (London, 1848), and *Étude historique sur le concile de Trente*, by L. Maynier (part i., Paris, 1874). Important "Documents relating to the History of the Council of Trent" have been published from Austrian archives by Tickel (Vienna, 1872). The long expected publication of the original acts of the council, by Augustin Theiner, prefect of the Vatican council, took place in 1874 (*Acta genuina Ss. Œcumenici Concilii Tridentini*, Agram); the work is believed to give, not the minutes of the council as they were taken down by the secretary, but a careful revision.

**TRENTE ET UN.** See Rouge et Noir.

**TRENTON,** a city and the capital of New Jersey and of Mercer co., on the left bank of the Delaware river at the confluence of Assunpink creek, and at the head of steamboat navigation, 28 m. N. E. of Philadelphia, and 55 m. S. W. of New York; lat. 40° 14′ N., lon. 74° 46′ 30″ W.; pop. in 1860, 17,228; in 1870, 22,874, of whom 5,019 were foreigners; in 1875, 25,031. The city is regularly laid out, and lighted with gas. Assunpink creek divides it into nearly equal parts, Trenton and South Trenton. Water is raised from the Delaware to a reservoir N. of the city. The capitol is a handsome stone building, recently enlarged, 240 ft. by 120, stuccoed in imitation of granite. The county court house is in South Trenton. There is also a good city hall. Trenton contains one of the state lunatic asylums, founded in 1848, and having accommodation for 600 patients; the state normal school, established in 1855, and having extensive buildings; the state penitentiary, and the state arsenal. There is now (1876) in course of construction by the United States government a large and handsome building, of Ohio sandstone, intended for the post office and United States courts and offices, to cost $500,000. The soldiers' children's home and the state industrial school for girls are near by. There are two bridges over the Delaware opposite the city, one 1,100 ft. long, built about 1810, and recently reconstructed of iron, and the other about 1,300 ft. long, completed in 1860. The Delaware and Raritan canal passes through the city, forming a water communication with Philadelphia and New York, and, by its navigable feeder, with Lambertville and New Hope, about 18 m. N. Trenton is connected with Philadelphia and New York by the Pennsylvania railroad, and is the point of junction with the Belvidere Delaware railroad, which runs to the Water Gap and connects with the coal regions of Pennsylvania. The manufacture of crockery is the most important industry, Trenton surpassing all other places in the country in this respect. There are 18 potteries, producing white granite and brown ware to the value of about $3,000,000 annually. The city also contains iron founderies, breweries, paper mills, woollen mills, rolling mills, rubber works, zinc works, and manufactories of engines and boilers, wire, terra cotta, belting and hose, edge tools, soap, carriages, nails, saws, scales, &c. There are two national banks with a joint capital of $1,000,000, a state bank with $500,000 capital, three savings banks, and two insurance companies with a joint capital of $700,000. The city is governed by a mayor and a common council of three members from each of the seven wards. It has street railroads and an efficient fire department. The principal charitable institutions are a home for widows, a children's home, and the hospital of St. Francis. There

State Capitol of New Jersey.

are a high school and 11 other public schools, with about 50 teachers and an average attendance of about 2,000 pupils, besides academies and Roman Catholic schools. The state library contains 20,539 volumes, the law library 15,000, and the public library about 5,000. Six daily, one semi-weekly (German), and six weekly newspapers are published. There are 34 churches, viz.: 4 Baptist, 3 Episcopal, 1 Evangelical Lutheran, 2 Friends', 1 Jewish, 1 Lutheran, 1 Messiah, 12 Methodist, 6 Presbyterian, and 3 Roman Catholic.—The first settlement in the vicinity was made about 1680, and was named in 1720 in honor of Col. William Trent, speaker of the house of assembly. It was selected as the capital of New Jersey in 1790, and incorporated as a city in 1792. On the night preceding Dec. 26, 1776, Gen. Washington crossed the Delaware river at McConkey's ferry, and attacked the Hessians, who were encamped in Trenton, surprising and routing them completely, taking about 1,000 prisoners, 6 brass field pieces, 1,200 stand of arms, and the standards of an entire brigade. The Hessians numbered about 1,300, and 17 were killed in the skirmish, while the Americans lost not a man in the fight, although two were frozen to death in recrossing the river. The force of the enemy in the vicinity being superior to Washington's, he returned to his camp on the other side of the Delaware on the night of the 26th.

**TRENTON FALLS**, a village of Oneida co., New York, on West Canada creek and the Utica and Black River railroad, 13 m. N. E. of Utica; pop. in 1870, 128. It is named from the falls in its neighborhood, six in number, occupying at intervals a ravine 2 m. long, with an aggregate descent of 312 ft. The cascades are exceedingly beautiful, and the rocky walls in some places are 150 ft. high.

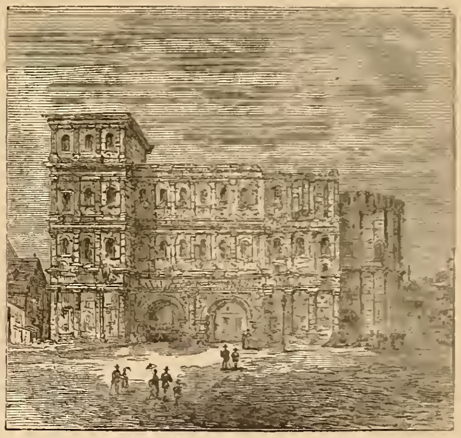
**TRENTSCHIN** (Hung. *Trenscény*), a N. W. county of Hungary, bordering on Moravia, Austrian Silesia, and W. Galicia; area, 1,784 sq. m.; pop. in 1870, 248,626, nearly all Slovaks and Roman Catholics. It is traversed by two branches of the Carpathian mountains, and watered by the Waag and its affluents. Its chief products are corn, fruit, flax, and hemp; and it has famous mineral springs. The capital, Trentschin, on the left bank of the Waag, is remarkable for the springs in its vicinity, and for its castle, one of the oldest and strongest in Hungary, situated on a rocky eminence; pop. in 1870, 3,449.

**TREPAN**, and **Trephine** (Gr. *τρυπᾶν*, to perforate), two surgical instruments used for removing portions of bone from the skull or other parts of the bony structure. The first was an instrument like a gimlet, to which was attached a crown or cylinder with saw teeth on its lower edge, and which was worked by a rotatory motion till it perforated the bone. Several sizes of these cylinders were furnished. The trephine is of later invention. It has a cylindrical saw, but no gimlet. A sharp steel point called a centre pin, which can be pressed into the bone until the saw has made a groove for itself, passes down the centre of the instrument, and is removable by the operator as soon as the groove is made. The cutting is accomplished, not as in the trepan by a rotatory movement, but by semi-rotation, as in boring with an awl. The method of trephining is as follows: A crucial incision is made down to the bone, and the periosteum being dissected up, the trephine is applied, the centre pin being removed as soon as the track of the instrument is fixed, and the instrument itself raised every few strokes in order to see that it is not cutting through on either side, upon the tissues below. The greatest danger is when the circular piece is nearly separated; and some operators raise the cut portion by means of the elevator, rather than permit the instrument to divide it completely. The spiculæ of bone which may remain around the orifice are carefully removed by means of forceps. Trephining has been considered as indicated when there is a fracture of a portion of the skull, from a fall or blow with a blunt instrument, in order to elevate the depressed portion; in some cases of concussion, where there is reason to believe that the inner table of the skull is fractured at the opposite side of the head, and is producing irritation of the brain; in cases where extravasation of blood has taken place under the meninges of the brain from injuries or disease, or where purulent matter has accumulated under the meninges; in caries affecting the bones of the skull, the sternum or breast bone, or the tibia; and in some cases of a collection of purulent matter under the sternum. During the middle ages, in the "heroic" period of surgical practice, trephining was one of the most common operations of surgery. Of late years the operation is but seldom practised. Hey's saw, with a shaft and handle like a common steel fork, and having a plate of steel 1½ in. in breadth and perhaps 1¾ in. long attached to it, one edge of which is a straight and the other a convex saw, has almost entirely superseded the trephine for most of those injuries of the skull which were formerly thought to require its use. By this instrument the depressed portion is itself removed, instead of that which was not fractured, and the injuries to the skull can be remedied with far less loss of bony structure than under the old system.

**TRESPASS** (Norman Fr. *trèspasser*, from *três*, beyond, and *passer*, to go), in law, as usually defined, a wrongful act, committed with some kind of violence, and injurious to the person, property, or rights of another. Its literal meaning is precisely the same as transgression; it is a step beyond the limits of law or right. In the old law Latin the word *transgressio* was used where trespass is used in English. Formerly the two words were employed in writing and conversation with the same meaning, but now trespass is commonly used

only in the legal sense, and is an important law term. Familiar examples of trespass are assault and battery, forcible entry into a house or upon lands, breaking open a door, and tearing down a fence. Such acts are in law trespasses *vi et armis*, or, in the English phrase now used in indictments and declarations, trespasses with force and arms. Early in the history of the law a very slight degree of violence was sufficient to constitute this offence; and soon afterward the law held that it might be committed in some cases without any actual force whatever, implying by construction the force necessary to make it a trespass *vi et armis*, if the act were unlawful. Thus, for example, a peaceable entry into a house or land, with intent to take possession and oust the true owner, was regarded as a trespass *vi et armis*. Soon after there grew up a large and very important class of trespasses, where there was neither actual nor constructive force. The courts in fact invented a form of action, by means of which remedies might be given for a great number of injuries, to which the law of trespass with force and arms could not be made applicable by any construction. This new legal trespass was called, in the law Latin in use when the action was first employed, *transgressio super casum*, and is now called a trespass on the case. In the days of special pleading it had become very difficult to determine whether the action by which redress was sought for in certain injuries should be trespass or trespass on the case; and if the plaintiff mistook his form of action, he wholly failed. But by recent statutes, with the rules of court and the amended practice, if a mistake be made it may be corrected without delay and without cost. Trespass with force and arms (or trespass alone, for the latter clause is often omitted) lies when the injury complained of is itself the wrong done by the defendant; while trespass on the case lies when the injury was consequential upon the wrong done, and flowed from it indirectly. For example, trespass on the case lies for an injury sustained by the plaintiff from the defendant's sale to him of unwholesome food, as meat or wine, especially where it was the business of the defendant to sell these things. So for an injury caused by the want of skill of any person in the exercise of his profession, as a physician or lawyer. There is yet another nice and very important distinction in the law of trespass. A man may begin by doing a right thing in a right way, and then so change his course as to do a wrong thing, or a right thing in a wrong way. In some of these cases such a person thus subsequently trespassing is regarded by the law as a trespasser *ab initio*, or as having been a trespasser through the whole of his conduct. Thus, if, in the execution of a legal process, he does something which is distinctly illegal, the law considers that he began to act with intent to do an illegal thing, and that all of his conduct was tainted by this intention and was therefore illegal. The doctrine is applied only where the wrong was done while in the exercise of a strictly legal right, which the injured party had no right to resist, and seems to be confined by the best authorities to the cases of an officer of the law acting under a legal warrant, and a guest at an inn.

**TREVES** (Ger. *Trier*), a town of Rhenish Prussia, on the right bank of the Moselle, 57 m. S. W. of Coblentz; pop. in 1871, 21,442. It is a decayed place, noted for its ultramontanism and for a cathedral which exhibits the development of the Romanesque style from the earliest period down to its completion in the 12th century, and contains remarkable altars, tombs, missals, and relics. (See *Der Dom zu Trier*, by Wilmowsky, Treves, 1875.) Among the relics is the so-called "holy coat," which pilgrims revere as the seamless garment of the Saviour, and believe to have been deposited in the church by the empress Helena, the alleged founder of the building. The great agitation



Porta Nigra, Treves.

which resulted in 1844 from the multitudes (estimated at more than 1,000,000) flocking to this shrine was the main origin of the German Catholic denomination. Adjoining the cathedral is the *Liebfrauenkirche* of the 13th century, one of the earliest and finest specimens of pure Gothic. The university, founded in 1472, was superseded in 1798 by a gymnasium, which contains a city library of 100,000 volumes. In the old electoral palace are the barracks. The Roman antiquities, more numerous here than anywhere else in Germany, include part of the bridge over the Moselle, an amphitheatre, baths, and the colossal quadrangle known as *porta nigra*, the most conspicuous of all. The chief articles of trade are fruit, wine, timber, stones, and woollen and other manufactures.—Treves was originally occupied by the Treviri, a Celtic tribe of Belgic Gaul, and under the Romans became the capital of a province under the name of Augusta Trevirorum. In the 4th century the town was improved by Constantine

the Great. Under the Franks it was included in the kingdom of Austrasia, and afterward belonged alternately to Lorraine and Germany, till in the 10th century it was permanently annexed to the latter country. Subsequently, under the rule of archbishops, it became with its territory the second German electorate, divided into an upper and lower see, the latter connected with the episcopal capital at Coblentz. The city of Treves was invested with sovereign rights from 1580 till its occupation by the French in 1794. The whole electorate was in 1797 incorporated with France. In 1814 Treves was annexed to Prussia. The suppression of the priests' seminary, Dec. 31, 1873, and the subsequent imprisonment of the bishop, produced disturbances which were quelled in March, 1874.

**TREVIRANUS. I. Gottfried Reinhold,** a German naturalist, born in Bremen, Feb. 4, 1776, died there, Feb. 16, 1837. He studied medicine at Göttingen, and after practising at Bremen became in 1797 professor of mathematics in the lyceum of that city. His works include *Physiologische Fragmente* (2 vols., Hanover, 1797–'9); *Biologie oder Philosophie der lebenden Natur* (6 vols., Göttingen, 1802–'22); *Erscheinungen und Gesetze des organischen Lebens* (2 vols., Bremen, 1831–'2); and with his brother *Vermischte Schriften anatomischen und physiologischen Inhalts* (4 vols., Göttingen and Bremen, 1816–'21). **II. Ludolf Christian,** a German botanist, brother of the preceding, born in Bremen, Sept. 10, 1779, died in Bonn, May 6, 1864. He became professor of medicine at Berlin in 1807, of botany and natural history at Rostock in 1812, professor of botany and director of the botanic garden at Breslau in 1816, and afterward at Bonn. He is chiefly known by his *Physiologie der Gewächse* (2 vols., Bonn, 1835–'9).

**TREVISO. I.** A N. E. province of Italy, in Venetia, bordering on the gulf of Venice; area, 941 sq. m.; pop. in 1872, 352,538. It is level, excepting in the north, and is one of the most fertile regions of that part of Italy. The main river is the Piave. The chief products are hemp, flax, grain, wine, and timber. It is divided into the districts of Treviso, Ceneda, Castelfranco, Oderzo, Asolo, Valdobbiadene, Montebelluno, and Conegliano. **II.** A fortified city (anc. *Tarvisium*), capital of the province, on the Sile, 15 m. N. N. W. of Venice; pop. in 1872, 28,291. It is the seat of a bishop, and has an unfinished cathedral, with works by Titian and Paul Veronese, a large Gothic church, a celebrated palace of justice, a lyceum, gymnasium, seminary, and academy of science. In the 13th century it was captured and oppressed by Ezzelino da Romano; in the 14th it was successively ruled by Francesco della Scala of Verona, by Venice, Austria, and Padua, and was with its territory in the possession of Venice from 1388 till the occupation of the town in 1797 by the French under Mortier, who in 1807 received the title of duke of Treviso. It afterward belonged to Austria. In March, 1848, it was taken by the revolutionists, but the Austrians regained it on June 24, after a second bombardment. In 1866 it became part of the kingdom of Italy.

**TRIADITZA.** See SOPHIA.

**TRIAL.** See JURY, and PROCESS.

**TRIBONIANUS,** a Roman jurist, died A. D. 545. Under Justinian he occupied the offices of *quæstor sacri palatii*, of *magister officiorum*, of prætorian prefect, and of consul. He is described as a man of great natural abilities and learning, but avaricious and corrupt. In 528 he was one of the ten commissioners selected by the emperor to form his first Codex, and in 530 was placed at the head of the committee to compile the Pandects or digest of Roman laws, which was finished and promulgated in 533. He at the same time, with two others, compiled the four books of the Institutes of Justinian, published in 533; and the second Codex of that emperor, published in 534, was the work of Tribonianus and four other jurists. (See CIVIL LAW.)

**TRIBUNE** (Lat. *tribunus*), originally, a Roman officer who presided over one of the three tribes, Ramnenses, Titienses, and Luceres. In the long course of Roman history the name came to be applied to various officers with widely different powers and duties. As originally constituted, the Roman legion consisted of 300 cavalry and 3,000 infantry; over the cavalry presided an officer called *tribunus celerum*, and over each 1,000 of the infantry a *tribunus militum*. The *tribuni celerum* disappeared with the overthrow of the monarchy. The office of the *tribuni militum* continued through the whole course of Roman history, but the manner of their appointment, their number, and their powers and duties were often changed. "Tribunes of the soldiers, with consular power," were first chosen in 444; and in succeeding years sometimes consuls and sometimes tribunes with consular power were chosen. In 367 the office was abolished, and thereafter only consuls were chosen. The name "tribune of the Servian tribes" is applied by historians to the administrative chiefs of the local tribes which were gradually added to the Roman commonwealth; it is supposed by Niebuhr and others that the tribunes of the treasury of later times were similar to them.—The "tribunes of the people" were the most important of all the officers bearing the name. They were first appointed after the secession of the commonalty to the Mons Sacer, in 494. They were empowered to protect the plebeians against the usurpations of the patrician magistrates, and their persons were declared sacred and inviolable. They appear to have been originally two in number, and to have been elected for one year by the comitia of the centuries. In 471, by the Publilian law, the election was given to the comitia of the tribes. About the same time the number was increased to five, and from 457 B. C. until the end of

the empire ten tribunes were annually elected. None but plebeians were eligible for the office; so that if a patrician were desirous of filling it, he was obliged to renounce his own order. The early incumbents of the office exercised authority within the city limits and over one mile of adjacent territory; the doors of their houses were ordered to be open day and night, and all persons taking refuge there were assured of protection. For similar reasons they were forbidden to absent themselves from the city for a whole day. Although their lawful power was originally merely *auxilium*, or the right to afford protection, they assumed within a few years the right to convoke the senate, and in 454, after a long struggle, secured the appointment of the three commissioners whose labors led to the codification of the laws of the twelve tables. During the second decemvirate the tribunate was suspended, but with the overthrow of that oligarchy it was restored with augmented powers; and as the tribes now included patricians and their clients as well as plebeians, the tribunes became the protectors of all classes of citizens. They now also acquired the right to be present at the deliberations of the senate, and to take part in its discussions, although not allowed to pass within the doors of the senate house; and hence they gradually assumed the privilege of intercession against any action taken by a magistrate, and by the interposition of their veto were enabled to annul any decree of the senate or stop any law, without cause or reason assigned. On the other hand, they sometimes interfered to compel the consuls to comply with decrees of the senate. About 132 B. C. they became senators by virtue of their office. They also assumed the right of commanding their *viatores* or attendants to seize a refractory magistrate, and imprison him, or even to hurl him from the Tarpeian rock. They possessed the exclusive power of proposing *plebiscita* to the comitia of the tribes; and after these had obtained by the Hortensian law, 286 B. C., the binding force of laws, the tribunes became a magistracy for the whole Roman people, in opposition to the senate and the oligarchical elements in general, although they had nothing to do with the administration of the government. Subsequent to 394 B. C. the veto of a single tribune sufficed to render a resolution of his colleagues void; and it was not until Tiberius Gracchus introduced the practice of appealing to the people to remove a tribune who obstinately adhered to his veto, that the harmonious working of the system was restored. During the latter period of the republic Sulla, in his reform of the constitution on an aristocratic basis, gave the tribunes merely the *jus auxiliandi* which they originally possessed. Pompey restored them to their former power, but under the empire their privileges became much restricted, although until the 5th century they continued to have the right of intercession against decrees of the senate and on behalf of oppressed individuals. The emperors, though patricians, found it necessary to be tribunes, and the *tribunicia potestas*, conferred by the senate upon Augustus and his successors, was considered an essential part of the imperial dignity.—After Diocletian there was an officer called *tribunus voluptatum*, who was the superintendent of public amusements.

**TRICHINA SPIRALIS.** See ENTOZOA, vol. vi., p. 669.

**TRICHINOPOLY,** or **Trichinapalli,** a town of British India, capital of a district of the same name in Madras, on the right bank of the river Cavery, in lat. 10° 47′ N., lon. 78° 43′ E., 190 m. S. S. W. of the city of Madras, with which it is connected by rail; pop. about 30,000. The fort of Trichinopoly is built on a granite rock about 600 ft. high. Outside the densely populated native town, which was formerly enclosed within the walls of the fortress, are extensive barracks, hospitals, public rooms, a church and Roman Catholic chapel, and the tomb of Bishop Heber, who died here. The surrounding country is fertile and populous; and the island of Seringham, which is here formed by the Cavery, is famous for the size and wealth of the Hindoo pagodas upon it. Trichinopoly is the southernmost station of British troops in India, and was occupied by 169 European infantry in 1872–'3. Cotton cloths, hardware, harness, cheroots, indigo, and jewelry are manufactured and exported to different parts of India and Mauritius.—Trichinopoly, after the death of its last rajah in 1732, fell under the sway of the nawaub of Arcot, and subsequently changed hands several times, figuring conspicuously in the contests of the French and English for supremacy in India. It finally came under English government with the rest of the Carnatic in 1801.

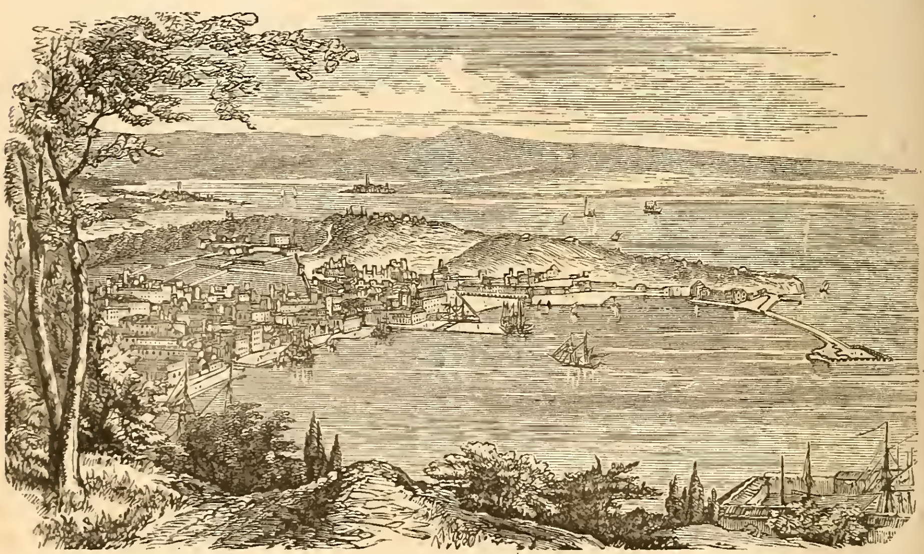
**TRICOLOR.** See FLAG, vol. vii., p. 250.

**TRICOUPIS, Spiridion,** a Greek historian, born in Missolonghi in 1791, died in Athens, Feb. 24, 1873. He held important offices at Athens after the Greek revolution, which he had promoted, and was minister at London at various periods, lastly from 1850 till King Otho's downfall in 1862. He was a friend of Lord Byron, on whose death he pronounced one of his most celebrated orations. His chief work is Ἱστορία τῆς Ἑλληνικῆς Ἐπαναστάσεως ("History of the Greek Revolution," 4 vols., London, 1853–'7; 2d ed., 1862).

**TRIER.** See TREVES.

**TRIESTE** (Ger. *Triest*). **I.** A district of Cisleithan Austria, forming a part of the Littorale, and bordering on the Adriatic, Görz, and Istria; area, 36 sq. m.; pop. about 132,000, of whom more than one half are Slovens, more than one third Italians, 8 per cent. Germans, and 4½ per cent. Jews. **II.** A city (anc. *Tergeste*), capital of the district, and the principal seaport of Austria, beautifully situated at the head of the gulf of Trieste, or N. E. coast of the Adriatic, 70 m. E. N. E. of Venice and 210 m. S. W. of Vienna; pop. in 1870, including

suburbs, 109,324. It consists of the old town, with a fortified castle, the new or Theresa town, and the new Joseph and Francis suburbs, with capacious streets and many squares and promenades. The finest public building is the chamber of commerce, formerly the exchange building. The monuments include the statue of Leopold I., and that by Rosetti of Winckelmann, who was murdered here. The cathedral is remarkable chiefly for walled-in antiquities. The recently opened Protestant church is one of the finest in the city. Trieste is the seat of a bishop, and has a theological seminary and many schools, besides a commercial and naval academy with an observatory, a museum rich in botany, and a public library. The "Adriatic Scientific Society" was established in 1874. The Tergesteum is the building of the Austrian Lloyd's, which company for steamboat navigation and miscellaneous enterprises is one of the largest organizations of the kind in the world. Trieste is Italian in appearance and in language, though much German is spoken. There are Greek and English merchants. The constant arrival and departure of steamers make the port very lively; but the increase of commerce and population is of comparatively recent origin. In 1758 the population was only 6,000. In 1873 the arrivals of vessels numbered 8,046, chiefly Italian and Austrian, and the departures 8,219, with a respective tonnage of 898,437 and 909,402. The imports, chiefly coal, grain, iron, and oil, amounted to 140,164,000 florins, and the exports, mainly grain, flour, timber, and staves, to 92,377,000 florins. This was a decline from previous years, due to the competition of Hamburg; and the sanguine expecta-



Trieste.

tions of increasing the importance of Trieste in the India trade have been rather damped since the opening of the Suez canal. Its status as a free port is limited by the government monopoly of gunpowder, salt, and tobacco, and by an excise upon wine, spirits, and other articles. A breakwater for protecting the port was begun in 1865, and an abortive attempt was made in 1874 to fill up the malarious part of the *canale grande*, originally intended to supplement the port and the roads.—Tergeste was originally settled either by the Carnians or Istrians. The earliest historical mention of it as a Roman town dates from 51 B. C. Augustus laid the foundation of its prosperity. It was under the dominion of the Ostrogoths, and afterward of the Greek emperors, till the period of the Lombard invasion. Subsequently Trieste became independent under its bishop, who bore the title of count, and who gradually sold to the inhabitants the privileges of a free city. Long wars ensued with the patriarchate of Aquileia, which claimed the allegiance of the bishops of Trieste, and in these wars Venice and Genoa also took part. The peace of Turin in 1381 acknowledged Trieste as an independent city, and the next year the citizens voluntarily submitted to the house of Austria. Charles VI. declared it a free city in 1719, and Maria Theresa made it a free port in 1750. It was taken by the French in 1797 and 1805. From 1809 to 1814 it belonged to the French province of Illyria, and subsequently to the Austrian kingdom of that name till 1849, when the so-called kingdom was dissolved. In reward for its fidelity to Austria during the revolutionary period of 1848-'9, when the port was blockaded by an Italian squadron, the city and district were invested on Oct. 2, 1849, with the privi-

leges of local self-government; and by the constitution of Dec. 21, 1867, they were made a constituent part of the Littoral province.

**TRIGG**, a S. W. county of Kentucky, bordering on Tennessee, bounded W. by the Tennessee river and drained by the Cumberland river; area, 530 sq. m.; pop. in 1870, 13,686, of whom 3,806 were colored. The surface is hilly and the soil fertile in parts. Horses, cattle, mules, and swine are exported in great numbers. Iron, bituminous coal, and limestone are found. The chief productions in 1870 were 99,371 bushels of wheat, 589,820 of Indian corn, 16,114 of oats, 14,805 of Irish and 18,832 of sweet potatoes, 3,614,363 lbs. of tobacco, 18,442 of wool, 83,308 of butter, and 534 tons of hay. There were 2,673 horses, 1,908 mules and asses, 2,440 milch cows, 3,311 other cattle, 9,439 sheep, and 24,288 swine; 4 flour mills, 1 manufactory of pig iron, 4 tanneries, 4 currying establishments, and 3 saw mills. Capital, Cadiz.

**TRIGONOMETRY** (Gr. *τρίγωνον*, a triangle, and *μετρεῖν*, to measure), the branch of mathematics which treats of the measurement of triangles. The practical object in nearly all applications of the science is to measure indirectly some height or some distance the direct measurement of which would be inconvenient or impossible. The labors of the civil engineer and the astronomer consist in great part in a constant application of the principles of trigonometry, and the best treatises on the subject, like that of Prof. Peirce, include also treatises on surveying, navigation, and spherical astronomy. Trigonometry is divided into plane and spherical, the former treating of plane triangles, the latter of spherical triangles. In surveying and ordinary engineering operations plane trigonometry is mostly employed; in the higher problems of navigation, in engineering operations conducted on a grand scale, as in the coast survey, and in astronomy, spherical trigonometry is indispensable. But the general principles are the same in both branches. As spherical trigonometry consists essentially in an extension of the principles of plane trigonometry, we shall confine our attention to the latter. In every plane triangle there are six elements to be considered, three sides and three angles. The angles depend upon the proportions of the sides, and conversely the proportions of the sides depend upon the angles. If we know the three angles, we can find the ratio which any one side bears to each of the others, but we cannot find the length of any one of them; hence it is necessary for the complete determination of all the elements of a triangle, that we should know the length of at least one side. In calculating the unknown elements of a triangle certain ratios are employed, called "trigonometrical functions," which depend upon the angles. One quantity is said to be a function of another when its value depends upon the value of the other. The ordinary method of measuring angles is explained under ANGLE.—There are two methods of explaining the trigonometrical functions. The one, which may be called the ancient method, is presented in nearly all the text books in use before the middle of the present century; the other or modern method is followed in the best text books of recent date, and is fast superseding the former. In the old system the trigonometrical functions are lines, in the new system they are abstract numbers expressing the ratios of lines. A brief explanation of the modern system will enable the general reader to form an idea of the nature and objects of the science. Draw two lines, C A, C B, fig. 1, forming an angle at C. At any point in either line, say at P in the

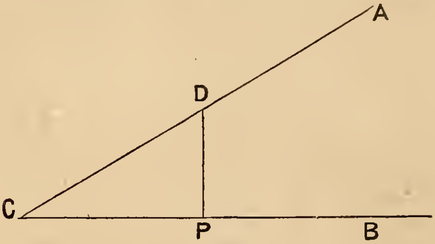



FIG. 1.

line C B, erect a perpendicular to C B, intersecting C A in D. It matters not where in the line C B the point P is; so long as the angle at C remains unchanged, the proportions of the lines C D, C P, and P D will remain the same. In the figure the angle at C is intended to be an angle of 30°; and with this angle, if C D is an inch, P D will be half an inch, and if C D is ten miles, P D will be five miles; in other words, with an angle of 30°, P D is always half of C D. The number $\frac{1}{2}$ is called the "sine" of 30°, or $\frac{PD}{CD} = \frac{1}{2} =$ sine of 30°. If the angle C be altered, the ratio $\frac{PD}{CD}$ will change, and hence the sine is said to be a function of the angle. But the sine does not vary directly as the angle. When the angle is a right angle or 90°, the lines C D and P D fall together and become one line, and their ratio is 1, or the sine of 90 = 1; and although the angle is three times 30°, the sine is only twice the sine of 30°. The ratio of C P to C D, or $\frac{CP}{CD}$, is called the "cosine" of the angle at C. The cosine of 30° is the decimal fraction 0·866 very nearly. The ratio of the sine to the cosine, or of the line P D to C P, is called the "tangent" of the angle at C. The tangent of 30° is $\frac{1}{2}$ divided by $\frac{866}{1000}$, or, in decimals correct to three places, 0·577. The sine and cosine are never greater than 1, and hence in all cases except where the line C D coincides with one of the other lines, the sine and cosine are fractions. The tangent may have any value. Thus the sine of 89° 3′ is 0·99986, and the cosine is 0·01658; both are fractions less than 1, but the former contains the latter more than 60 times,

and the tangent of 89° 3′ is 60·3058. The reciprocals of the sine, cosine, and tangent (that is, $\frac{1}{\text{sine}}$, $\frac{1}{\text{cosine}}$, $\frac{1}{\text{tangent}}$) are called respectively the cosecant, secant, and cotangent of the angle at C. If the cosine be subtracted from 1, the remainder is called the "versed sine;" and if the sine be subtracted from 1, the remainder is called the "coversed sine." In practice these names are always abbreviated. Instead of "sine of 30" it is always written sin 30°, and, putting C for the angle, the abbreviations are as follows: sin C, cos C, tan C, cosec C, sec C, cotan C, covers C, and vers C. These terms all indicate numbers depending on the value of the angle, and are called the "trigonometrical functions." The value of these functions has been calculated for all possible angles which our most delicate instruments enable us to measure, and these values are recorded in tables, so that, any angle being given, the functions can be found, or any function being given, the angle can be found, by simply looking in the tables. The numbers employed in trigonometry, especially where great accuracy is required, often contain so many digits that the labor of calculation would be intolerable were it not for the use of logarithms. The tables generally used in practice contain, not the actual values of the functions, but the logarithms of those values. Tables of the actual values are also published, and they can be easily found, if wanted, from their logarithmic values by means of a table of the logarithms of numbers. A single example of the use made of these functions will show how measurements can be made which without them would be inconvenient or impossible. Suppose a person at B, fig. 2, on the bank of a river, on

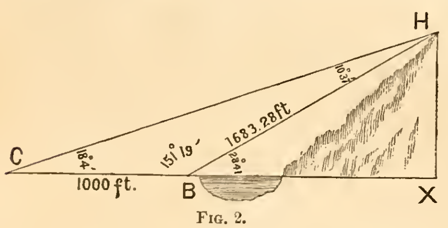



Fig. 2.

the opposite side of which is a lofty hill, whose highest peak H he can see with his telescope. He wishes to know the perpendicular height of the peak (H X) above the plain C B. Supposing him to be provided with the proper instruments for measuring angles, he takes a sight at the peak H and finds that the angle of elevation X B H is 28° 41′. Subtracting this from 180°, he finds the angle H B C = 151° 19′. Next he measures back from the river say 1,000 ft. to C, and then takes another sight at the peak and finds that the angle H C X is 18° 4′. The rest is matter of calculation and looking in the tables. The angles are quickly and easily measured, and the only physical labor of any consequence is the carrying his instruments from B to C and measuring the distance of 1,000 ft. between them. Any other distance than 1,000 ft. would have answered the purpose; but, for reasons which it is not necessary to enter into, it will save trouble and insure accuracy to have the distance B C as near as a rough guess will give to B H. Geometry tells us that if from the angle H B X = 28° 41′ we subtract the angle H C B = 18° 4′, we shall get the angle C H B, between the two lines of sight. We thus find C H B = 10° 37′. The text books on trigonometry show that in every triangle the sines of any two angles are to each other as the sides opposite the angles. Looking in a table of natural sines (that is, of the actual values, and not the logarithms), we find the sine of 10° 37′ is the decimal fraction 0·18424, and the sine of 18° 4′ is 0·31012. The side opposite the angle C H B we have measured, and hence we have the proportion, or "sum in the rule of three:" as 0·18424 is to 0·31012, so is 1,000 to B H, the side opposite the angle H C B. Making the calculations, which are much more easily made by means of logarithms, we get 1683·28 ft. as the distance from B to H. We now apply the same process to the triangle B H X. The angle B H X is a right angle, and its sine is 1. The sine of 28° 41′ is 0·47997; hence, as 1 is to 0·47997, so is 1683·28 to H X, the height which we wished to find; making the calculations, we find it to be 807·92 ft., or, taking the nearest foot, we say the peak is 808 ft. high. We have only made use of the sines; but all the other functions may come into play, according to the nature of the problem.—The great mathematicians of modern times have shown how trigonometry can be treated as a branch of pure algebra, and all its formulas developed without any reference to triangles. They have also shown how in this abstract form it can be applied to geometry, and a perfectly intelligible explanation given to what are called imaginary or impossible quantities. Treated in this manner, it constitutes the connecting link between the mathematical sciences of the present and those higher but as yet undeveloped branches of the mathematics of the future that have been referred to in the article Geometry, and the foundations of which have been laid in the "Quaternions" of Hamilton, the *Ausdehnungslehre* of Grassmann, and the "Linear Associative Algebra" of Peirce.—Among the multitude of works on the science, the following are of special excellence: A. De Morgan, "Trigonometry and Double Algebra" (London, 1849); J Todhunter, "Plane Trigonometry" (4th ed., London, 1869) and "Spherical Trigonometry" (3d ed., 1871); L. Mack, *Goniometrie und Trigonometrie* (Stuttgart, 1860); and C. Briot and A. Bouquet, *Leçons nouvelles de trigonométrie* (4th ed., Paris, 1862). (For the application of trigonometry to surveying, see Coast Survey, and Surveying.)

**TRILLIUM** (Lat. *trilix*, triple, the parts being in threes), a genus of North American plants,

now placed in a suborder of the lily family. They are perennial herbs with a short tuber-like rootstock, from which rises a simple, naked stem, usually less than a foot high, bearing at its summit a whorl of three ovate or rhomboid, netted-veined leaves, above which is a terminal flower, usually large, succeeded by an ovate, purple or red, three-celled berry. The trilliums, of which there are about a dozen species, are among the most striking of our spring flowers; their symmetrical structure and the beauty of the flowers in most species are interesting and attractive; they grow in rich moist woods or bogs, some extending from Canada to Georgia, one being peculiar to the far southern states, and two or three to the Pacific coast. The plants have received various common names, among which are three-leaved nightshade, wakerobin, birthroot, bethroot, and Indian balm. The great-flowered trillium (*T. grandiflorum*) is the

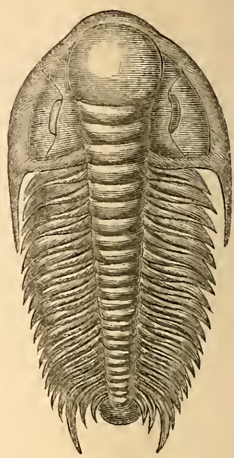
Large-flowered Trillium (Trillium grandiflorum).

showiest species; its pure white flowers, often 3 in. across, and becoming rose-colored with age, are erect and raised above the leaves on a peduncle 2 to 3 in. long. The purple trillium (*T. erectum*) has rather smaller, dull purple flowers. The red-fruited species (*T. erythrocarpum*) has its white petals marked at the base with pink or purple stripes. The nodding trillium hides its flowers beneath the leaves by the recurving of its stalk. *T. sessile* often has its leaves blotched with two shades of green; and the related *T. discolor*, the southern species, has very ornamental foliage from being variegated with green and brown or purple. All flourish well in the garden, *T. grandiflorum* being especially ornamental; large numbers of its tubers are sent to Europe, to be sold by the bulb dealers. The roots of *trillium* contain an acrid principle analogous to senegine and saponine, as well as a volatile oil, resin, and tannic acid. They are astringent, and are said to be tonic and expectorant.

**TRILOBITE** (Gr. τρεῖς, three, and λοβός, lobe), the name of a group of fossil crustaceans, so called from the three lobes into which the body is divided. They do not correspond exactly to any living group, but, according to Burmeister ("Organization of Trilobites," Ray society's publications, 4to, London, 1846), were a peculiar family of crustaceans, nearly allied to the existing *phyllopoda* (like *apus* and *branchipus*), and forming a connecting link between these and the entomostracan *pœcilopoda* (like *argulus*, *caligus*, and other parasites called fish lice); they come nearest to phyllopods, especially in the double large eyes, undeveloped antennæ, and soft membranous feet, and nearest of all to *branchipus;* a marked resemblance in the form of the *limulus* (king crab, or common horseshoe of our coasts), especially the larva, is also observed to that of many species of trilobites. (See KING CRAB.) The general form of the animal is oval, divided into three well defined regions, the head or buckler, the thorax, and the abdomen or *pygidium*, the last two composed of semicircular plates or segments, varying in number, by whose movements the animal could roll itself into a ball like the common wood louse and pill bug (*oniscus* and *armadillo*). Each of these three divisions presents three lobes limited by two longitudinal depressions; the head is generally the largest and considerably the widest, varying from one fourth to one half the total length, semicircular, with a border often ornamented with granulations, depressions, and spines; the middle portion is the *glabella*, the grooves which mark its lateral limit corresponding, according to Barrande, to the insertion of the jaws or first pair of feet; the different pieces are united by distinct sutures, which are important zoölogical characters. Eyes have been denied to some genera; some had eyes when young, but lost them when old; others had two well formed, compound, facetted, prominent eyes, which are often perfectly preserved in the fossil state; they are sometimes larger than half the length of the head, the greatest diameter being almost always the longitudinal; they had no simple eyes. Traces of a mouth have been distinguished in a few; no traces of antennæ have been found, and they were probably short and feebly developed. The number of the thoracic segments varies in different genera and at different stages of growth, but is constant in adults of the same species; the terminal portions on the sides are the *pleuræ*, and are curved backward and sometimes very long; traces of nine pairs of feet have been discovered, and they were doubtless soft, membranous, and leaf-shaped, as in *phyllopoda*. The *pygidium* was made up of segments like those of the thorax, but consolidated to form a posterior buckler; it was usually semicircular, less long than wide, developed inversely to the thorax, and largest in the more recent genera. The shell had a thinner horny membrane cover-

ing it, becoming more delicate toward the median line; between the two is found in the fossils a stony layer measuring their distance from each other; the lower surface was soft and membranous; the skin was undoubtedly cast as in other articulates, and Wahlenberg has suggested that some supposed new species may have been founded on their cast shells. They have been divided into three families, according to the nature of their covering: 1, *eurypteridæ*, without shell, including the single genus *eurypterus* (De Kay); 2, *cytherinidæ*, with bivalve, bean-shaped shell, including the single genus *cytherina* (Lam.); and 3, *trilobitæ*, with a shell having as many rings as there are joints to the body, containing many genera and species, and divided into two large groups, one with the power of rolling into a ball, like *calymene*, and the other with no such power, as in *ogygia*. According to Burmeister, the trilobites moved only by swimming, just below the surface of the water, with the back downward, rolling into a ball when danger threatened from above, and did not creep upon the bottom; they lived in shallow water, near the coast, associating in immense numbers, chiefly of the same species; while only six or eight species occur in a given stratum, the number of individuals was very great; their food consisted of small aquatic animals and their spawn; they underwent progressive metamorphoses, and varied considerably according to age; their metamorphoses are given at length by Barrande, who makes four distinct types, according to the serial development of the different parts.—Trilobites are among the oldest of the articulata; though none are now living, during the palæozoic period they were very abundant, and almost the only representatives of their class. They have been most studied in Bohemia, and by M. Barrande. None are found above the carboniferous rocks, and only two or three in them. Barrande's primordial fauna, or the lower Silurian, has one genus but no species passing to his second fauna or middle Silurian, and this has many genera but no species common to it and the third fauna or upper Silurian, which in turn has several genera passing to the Devonian fauna—the whole series affording remarkable proofs of the limitations of faunæ in time; the distribution of particular genera and species in space was also very circumscribed, probably on account of their feeble locomotive powers. In America several trilobites, especially *paradoxides* and its allied genera, have been met with in slates formerly classed among the metamorphic rocks, as the *P. Harlani* (Green), found in Braintree, Mass., in 1856, by Prof. W. B. Rogers, and this and other trilobites found in Canada and Newfoundland.—The trilobites have long attracted much interest, as well on account of the great numbers in which they have been found in many localities, as from their singular conformation, and the perfect state in which their forms are preserved. The eye is very beautiful, and its perfection in many of the stony fossils, especially some brought from the Hartz mountains, and from the upper Silurian limestone of Dudley, England, is very remarkable; the facets or lenses, sometimes nearly 400 in number, are like those observed in the eye of the dragon fly and butterfly, and as in these insects are arranged around a conical tube through which the visual rays enter from almost every direction; in the *asaphus caudatus* each eye thus has a range of nearly three fourths of a circle, and both together command a panoramic view. The structure of the eye also indicates the prevalence in those ancient periods of the same conditions of the waters and the atmosphere, as regards their adaptation to the organs of vision, as now obtain.—The geographical range of trilobites is very extensive; these fossils are met with at most distant points, both of the southern and northern hemispheres; they are found all over northern Europe, and in numerous localities in North America, in the Andes of Bolivia, and at the Cape of Good Hope. Trenton Falls, N. Y., has afforded, in the limestone known by its name, fine specimens of the species *calymene Blumenbachii* (Brongn.). Lebanon, Ohio, is another interesting locality. In Adams co., Ohio, Dr. Locke procured an *isotelus*, to which he gave the specific name *megistos*, that measured more than 20 in. in length and 12 in. in width; the *I. gigas* and *paradoxides Harlani* have been found more than 12 in. long. (See "American Journal of Science," 1871, p. 228, and 1872, p. 268.)

Calymene.



Paradoxides Harlani.

**TRIMBLE**, a N. county of Kentucky, bordering on the Ohio river; area, 150 sq. m.; pop. in 1870, 5,577, of whom 456 were colored. The surface is generally hilly and the soil fertile. The chief productions in 1870 were 31,848 bushels of wheat, 209,060 of Indian corn, 38,216 of oats, 12,647 of potatoes, 658,465 lbs. of tobacco, 10,676 of wool, 24,370 of butter, and 1,268 tons of hay. There were 1,906 horses, 1,064 milch cows, 1,882 other cattle, 3,043 sheep, and 6,512 swine. Capital, Bedford.

**TRINCOMALEE**, a town of Ceylon, in the N. E. part of the island, in lat. 8° 34′ N., lon. 81° 12′ E.; pop. about 20,000. It stands on the N. side of the entrance to a capacious and se-

cure harbor at the foot of well wooded hills and two heights crowned by forts, besides which the port is defended by numerous fortifications which extend for about a mile along the shore. The inner harbor is landlocked, and has the advantage over all other harbors of India of being accessible to all descriptions of ships during both monsoons. The inhabitants are mostly of Tamil origin, from the S. E. coast of India. The trade is of little importance, but precious stones are found in the neighborhood in considerable quantities.—The Portuguese were the first European nation to form a settlement at Trincomalee. They were expelled by the Dutch, who were in turn driven out by the British in 1782; but an insufficient garrison having been left for its defence, it was captured by the French, who restored it to the Dutch. In 1795 the British again captured it after a siege of three weeks, and it has since remained in their possession.

**TRINIDAD,** one of the British West India islands, at the mouth of the gulf of Paria, off the N. E. coast of Venezuela, opposite the N. mouth of the Orinoco, between lat. 10° and 11° N. and lon. 61° and 62° W.; length N. and S. about 50 m., average breadth 35 m.; area, 1,755 sq. m.; pop. in 1871, 109,638. Its N. W. and S. W. extremities are within 7 and 13 m. respectively of the continent. There is excellent anchorage between the island and the mainland, and there are several good harbors. It is crossed by three ranges of hills from W. to E., extending through the centre, and bordering the S. and N. coasts, the northern range attaining an elevation of 3,000 ft. There are level and undulating tracts in the valleys, but in some places the surface is considerably broken, and it is drained by rivers with numerous tributaries. Much of Trinidad appears to have been formed by the mud deposited by the Orinoco. The mountains consist of clay and mica slate; and quartz, pyrites, arsenic, alum, sulphate of copper, graphite, and sulphur are found. In a volcanic district on the W. coast there is a celebrated asphalt lake. (See Asphaltum, and Bitumen.) At Port of Spain, the capital, the temperature ranges between 74° and 86° in summer, and 70° and 81° in winter. The annual fall of rain is 65 inches; the island is beyond the range of hurricanes. The soil is fertile, and the elevated parts are covered with dense forests. The chief productions are sugar cane, coffee, and cacao; and cotton, indigo, tobacco, nutmegs, cinnamon, and cloves are raised. The indigenous animals are two species of small deer, the opossum, armadillo, porcupine, ant bear, sloth, muskrat, tiger cat, two species of lizards, and numerous monkeys. Fish are abundant. The settlements are chiefly on the N. W. coast and in the adjacent valley. A considerable trade is carried on with the United States in lumber and provisions. Trinidad is a crown colony, under a governor with executive and legislative councils.—The island was discovered by Columbus in July, 1498, occupied by the Spaniards in the 16th century, captured by the French in 1676, but soon restored, and taken by the British in 1797.

**TRINITY** (Gr. τριάς, Lat. *trinitas*), a term of Christian theology denoting the coexistence in the Godhead of three persons, distinguished from each other as the Father, the Son, and the Holy Ghost or Holy Spirit. The doctrine of the Trinity is held by the Roman Catholic church, and by most of the Protestant and eastern churches. The doctrine, it is contended, is contained in all its constitutive elements in the Scriptures, and was gradually drawn up into a systematic statement as the necessity occurred of preserving or vindicating it in its integrity and purity. Supplementary to the ecclesiastical form of the dogma itself are certain theological explanations, throwing on it a fuller light, derived from the teachings of early councils, the writings of the great church fathers, or the accepted scientific language of the schools. These regard the mode of origination of the second and third persons, the relations existing between the persons in the Trinity, and their distinctive characteristics and appellations. While the word Trinity is not to be found in the Bible, and while no passage can be adduced from the Old Testament in which the doctrine of the Trinity or its equivalent is distinctly and explicitly formulated, many texts have been quoted even by the earliest Christian writers which point to the existence of some form of plurality in the Godhead. These texts, however, being susceptible of various interpretations, are not produced as proving peremptorily the doctrine of a Trinity, but as foreshadowing the clear and distinct revelation believed to have been made in the New Testament. From it two large classes of texts are quoted as arguments for establishing the doctrine: those in which Father, Son, and Holy Spirit are mentioned in connection, and those in which these three subjects are mentioned separately, and in which their nature and mutual relation are more particularly described. The disputes about the tripersonality of the Godhead date from the apostolic age, and were occasioned chiefly by the prevalence of the Hellenistic and Gnostic theosophies. Theophilus, bishop of Antioch in the 2d century, used the word τριάς, and its equivalent *trinitas* was first employed by Tertullian in the 3d century. During the ante-Nicene period there was uninterrupted controversy about this doctrine, principally in the East, and many opinions were proscribed by the church as heretical. Among them were those of the Ebionites, who regarded Jesus as a mere man; of the Sabellians, according to whom the Father, the Son, and the Holy Ghost were only the different forms in which the one God reveals himself to men; of the Arians, who taught that the Son was not coeternal with the Father, but created by him before the world, and therefore subordinate and in-

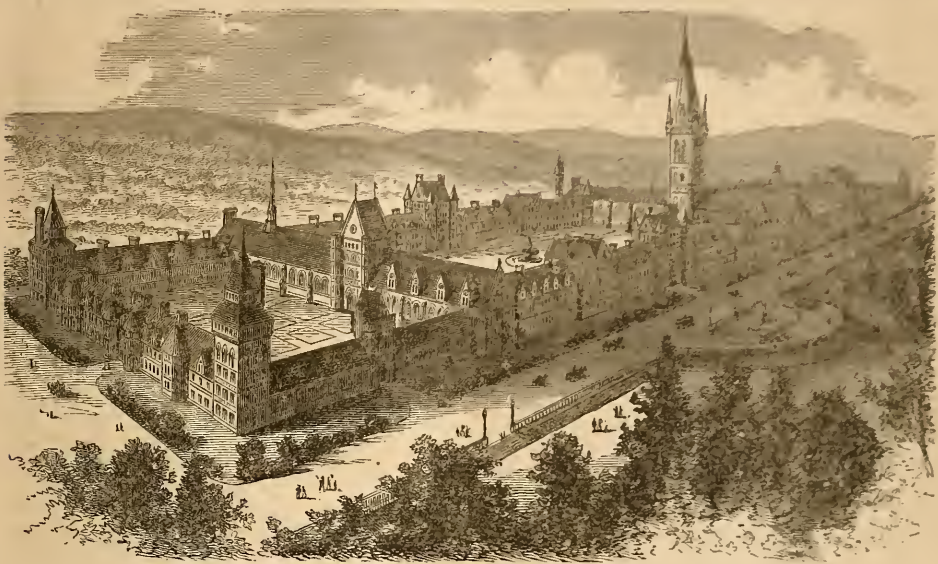
ferior to the Father; and of the Macedonians, who denied the personality of the Holy Ghost. The doctrine of the church was fixed by the councils of Nice (325) and Constantinople (381), which declared that the Son and Spirit are coequal with the Father in the divine unity, the Son eternally begotten by the Father, and the Spirit proceeding from the Father. The synod of Toledo (589) declared that the Holy Ghost proceeded also from the Son (*filioque*), and this addition was finally adopted throughout the Latin church; but the Greeks, though at first acquiescent and silent, at length protested against this change of the creed as an innovation, and the phrase *filioque* still remains one of the chief hindrances of a reunion between the Greek and Roman Catholic churches. The symbolic books of the Lutheran and Reformed churches retained the Roman Catholic doctrine of the Trinity unchanged; but it has been attacked ever since the 16th century, as contrary to both the Bible and sound reason, by a large number of theologians and by several new denominations, as the Socinians, the German theosophists (Weigel, Boehm, &c.), the Unitarians, and the Universalists. Swedenborg referred the Trinity to the person of Christ, teaching a trinity, not of persons, but of the person, by which he understood that that which is divine in the nature of Christ is the Father, that the divine which is united to the human is the Son, and the divine which proceeds from him is the Holy Spirit. The spread of rationalism in the Lutheran and Reformed churches undermined for some time the belief in the Trinity among a large number of German theologians. Kant held that Father, Son, and Spirit designate only three fundamental qualities in the Deity, power, wisdom, and love, or three agencies of God, creation, preservation, and government. Hegel and Schelling attempted to give to the doctrine of the Trinity a speculative basis; and after their example the modern dogmatic theology of Germany has in general undertaken a defence of the doctrine of the Trinity on speculative as well as theological grounds. Some supranaturalist theologians do not hold the strict doctrine of ecclesiastical orthodoxy, as defined by the councils of Nice and Constantinople, and the view of Sabellius especially has found in modern times many advocates.—Exhaustive works on the history of the doctrine of the Trinity have been published by Baur (*Die christliche Lehre von der Dreieinigkeit*, Tübingen, 3 vols., 1841–'3) and Meier (*Die Lehre von der Trinität in historischer Entwickelung*, Hamburg, 1844). See also Hodge, "Systematic Theology" (3 vols., New York, 1872–'3).

**TRINITY.** **I.** An E. county of Texas, bounded N. E. by the Neches and S. W. by the Trinity river, and drained by several creeks; area, 945 sq. m.; pop. in 1870, 4,141, of whom 1,084 were colored. The surface is nearly level, and the soil fertile. The Houston and Great Northern railroad passes through the W. part. The chief productions in 1870 were 94,240 bushels of Indian corn, 31,083 of sweet potatoes, 48,260 lbs. of butter, and 2,205 bales of cotton. There were 1,318 horses, 4,872 milch cows, 10,051 other cattle, 1,694 sheep, and 12,648 swine. Capital, Sumpter. **II.** A N. W. county of California, bounded E. by the Coast range, intersected by the Trinity, and drained by tributaries of Eel river; area, 1,800 sq. m.; pop. in 1870, 3,213, of whom 1,099 were Chinese. The surface is generally hilly and in the E. part mountainous, Mt. Linn, the highest peak of the range, lying in the S. E. corner. There are extensive forests of fir, pine, and oak. Gold mining is prosecuted to a considerable extent, and other valuable minerals are found. The chief productions in 1870 were 9,898 bushels of wheat, 5,658 of potatoes, and 1,017 tons of hay. There were 185 horses, 425 milch cows, 1,283 other cattle, 371 swine, and 5 saw mills. Capital, Weaverville.

**TRINITY.** **I.** A river of Texas, formed by the West fork and Elm fork, which rise near the N. boundary of the state, and, after a course of about 150 m. each, unite in Dallas co., whence the main stream flows in a tortuous but generally S. S. E. direction to the N. extremity of Galveston bay, about 35 m. from Galveston city. Its whole course lies through a valley of great fertility, occupied in part by extensive plantations of corn, cotton, rice, and sugar. The length of the main stream is about 550 m., of which about 250 m. is navigable. **II.** A river of California, rising in Trinity co., and flowing S. S. E., then S. W., and finally N. W. into the Klamath river, in lat. 41° 20′ N. It is celebrated for its rich gold mines.

**TRINITY COLLEGE**, an institution of learning in Hartford, Conn., under the control of the Protestant Episcopal church, chartered in 1823 and opened in 1824. Until 1845 its name was Washington college. Its presidents have been: 1824–'31, the Rt. Rev. Thomas C. Brownell, D. D., bishop of Connecticut; 1831–'7, the Rev. N. S. Wheaton, D. D.; 1837–'48, the Rev. Silas Totten, D. D.; 1848–'53, the Rt. Rev. John Williams, D. D.; 1853–'60, the Rev. Daniel R. Goodwin, D. D.; 1861–'4, Samuel Eliot; 1864–'6, the Rt. Rev. J. B. Kerfoot, D. D.; 1867–'74, the Rev. Abner Jackson, D. D. Dr. Jackson was succeeded by the Rev. T. R. Pynchon, D .D., who still holds the office (1876). In 1872 the college grounds were sold for $600,000, to be used as a site for the new state capitol. Soon afterward the college purchased 78 acres within the city limits, a mile south of the old location. There is now in process of erection here an imposing college structure, in the form of a quadrangle 1,050 ft. long and 376 ft. wide, and enclosing three courts containing an aggregate of about four acres. It is in the early English style of architecture, with gateways and a noble tower and spire 240 ft. high. It will comprise dormitories for 300 students, recita-

tion rooms, chapel, library, museum, dining hall, theatre, astronomical observatory, and dwellings for the faculty. The college is to be removed to the new site in 1877. The whole number of the alumni of Trinity college is 1,063, of whom 262 have been ordained to the



New Buildings of Trinity College, Hartford.

ministry. In 1875–'6 there were, besides the president, 8 professors, 3 other instructors, and 2 lecturers; the total number of students was 83. The course of instruction, in which all the studies are prescribed, occupies four years. Students may take special courses in studies pertaining to science, and on their completion receive the degree of bachelor of science. Besides 37 scholarships entitling the holders to free tuition, there are several which yield to needy students annual incomes ranging from $100 to $300. Nearly all of them are designed to aid students preparing for the ministry in the Protestant Episcopal church. The college has property amounting in 1875 to $1,068,296, a library of 18,000 volumes, exclusive of pamphlets and duplicates, and a valuable cabinet. Excepting $16,000 received from the state, the funds of the college have been contributed by individuals. A theological school was organized in 1851, and was continued for about three years, when the Berkeley divinity school at Middletown was established to take its place.

**TRIPANG.** See SEA CUCUMBER.

**TRIPOLI,** an earthy substance, originally procured from Tripoli in Africa, used as a polishing material, of fine sharp grain, yellowish gray or whitish, burning white. It consists almost entirely of silica, and when examined by the microscope is found to be composed of the exuviæ or skeletons of infusoria, the families of which are readily recognized. Specimens of it from Bilin and Franzensbad in Bohemia, Santafiora in Tuscany, and Mauritius have been examined by Ehrenberg. The substance has sometimes been confounded with the English rotten stone.

**TRIPOLI** (called by the natives *Tarabul*). **I.** A country of N. Africa, forming one of the Barbary states, and a dependency of the Turkish empire, bounded N. by the Mediterranean, E. by Barca, S. by Fezzan and the desert of Sahara, and W. by the Sahara and Tunis, between lat. 28° and 33° 15′ N., and lon. 10° and 20° E.; extreme length about 650 m., breadth from 130 to nearly 300 m.; area estimated at 125,000 sq. m.; pop. estimated at from 500,000 to 750,000. Including Barca and Fezzan, which are dependent states, the area of Tripoli is more than double that above given, and the population probably twice as large. Though the sea coast extends upward of 600 m., there is only one good harbor, that of Tripoli, in its entire length. In its E. part, between Cape Mesurata and the town of Benghazi in Barca, there is a vast indentation called by the ancients Syrtis Major, now the gulf of Sidra. (See SYRTIS.) A marshy tract 100 m. in length and varying in breadth from 2 to 40 m. extends parallel to the S. W. shore of the gulf. The western portion of the Tripolitan coast is low and sandy; but in the east it becomes higher, and has many rocky points that afford shelter to small craft, with good anchorage in some places. The soil is exceedingly porous, and most of the streams flow only during the rainy season. The interior of the country is imperfectly known. The N. E. part contains extensive tracts of barren sand, and partakes of the nature of the desert; but the S. part is

traversed by the Black mountains, descending in terraces which enclose fertile tracts. In the west two ranges of mountains, offsets of the Atlas, run nearly parallel with the sea, the N. range about 20 m. from the coast, and the S. 30 m. further inland. The former has a general height of about 2,000 ft., and is visible from the sea. These mountains are of volcanic origin, and many of the summits terminate in conical peaks. The space between the ranges contains many tracts of elevated table land, with a fertile soil produced by the decomposition of lava and basalt. Salt and sulphur are the only minerals obtained. Some of this land is carefully cultivated and irrigated. Abundant crops of grain are raised, and on the sides of the hills vines, olives, figs, almonds, and other fruits grow luxuriantly. There are extensive natural pastures upon which cattle are reared in great numbers. But the most fertile part of Tripoli is the country which surrounds the capital. This tract, about 5 m. broad, extends about 15 m. along the shore, and produces heavy crops of wheat, barley, millet, and maize. Dates and olives are grown, together with all the fruits of a temperate climate. The country S. of the plateaus contains very little productive land, and consists mainly of sand and gravel plains. The water, which is found only by digging from 100 to 200 ft., is bitter and brackish. In the few spots where grain can be raised there are villages, the inhabitants of which live in constant dread of the desert tribes. Rain falls abundantly in the N. part of the country from November to March, but during the rest of the year months often pass without a single shower, although there are copious dews in the summer, and the heat becomes very great, especially when the sirocco blows. In winter the weather is exceedingly variable, and frosts occur at night, while the temperature during the day often exceeds 70°. The horses of Tripoli are of a superior breed, and cattle are numerous on the table lands. Camels are extensively used as beasts of burden, and sheep and poultry are exported. Of wild animals the most common are wolves, foxes, hyænas, jackals, gazelles, antelopes, rabbits, hares, hedgehogs, and jerboas. Ostriches frequent the borders of the deserts, and most of the common birds of southern Europe are found. Bees are kept in large numbers, and the locusts which frequently visit the country in enormous swarms are utilized for food.—Tripoli contains numerous remains of antiquity, including ruins of Roman temples, theatres, and aqueducts. Many of these ruins have been buried deeply in the sand, but they can still be traced in the city of Tripoli and at other places. Coins, gems, and intaglios have been found in considerable numbers.—The population comprises Arabs, Moors, Turks, Mamelukes, Jews, and negro slaves. The Arabs form the greater part of the population in the country districts. The towns, of which Tripoli, Lebda, and Mesurata or Misratah are situated on the coast, are peopled mostly by Moors, Jews, and negro slaves. Some of the Arabs have fixed homes and reside in villages, but many of them are nomadic.—There are some manufactures of woollen goods, and cloth for tents is made of goats' hair. The trade of Tripoli is considerable. The exports by sea consist chiefly of wool, cattle, hides, gold dust, ostrich feathers, ivory, gum, dried fruits, saffron, senna, drugs, barilla, and sheep's fat; and the chief imports are clothes, spices, sugar, coffee, spirits, arms, cutlery, and hardware. In 1874 the exports to Great Britain were valued at £125,211, and the imports from that country at £238,257. Caravans arrive from the interior of Africa twice a year, and bring slaves, gold dust, and tropical commodities, which are exchanged for European goods.—The government of Tripoli is a pure despotism. The country in the wider sense is denominated a vilayet or province of Turkey, and its ruler is known as the bey. He is a pasha generally selected by the sultan from among the Turkish officers resident at the capital. In former times the revenue was chiefly derived from the prizes taken by corsairs, and the sale of captured Europeans into slavery; but since these sources were cut off, a system of monopolies has been adopted. The bey of Fezzan and the sheikhs of Barca and some neighboring tribes pay tribute, and taxes are imposed on land, on Jews and merchants, and on exports and imports. A considerable number of Jews and Christians reside in Tripoli, but the dominant religion is Mohammedan. The temperance enjoined by the prophet is not practised. Wine shops are kept openly, and receive the sanction of the government by paying a heavy license fee. Education is neglected, and the people are ignorant and bigoted.—Tripoli was conquered by the Romans from the Carthaginians, and became a part of the Roman province of Africa under the name of Regio Syrtica. Its present appellation appears to have originated in a federation of three cities, Sabrata or Abrotonum, Œa, and Leptis Magna (the present Lebda), whence the region was called Tripolitana. It was conquered by the Vandals in the 5th century, and by the Mohammedans shortly after the death of Mohammed. After the division of the eastern caliphate Tripoli became an independent state. The capital was taken by Roger II. of Sicily in 1146, and retaken by Yakub and the fortifications destroyed in 1184. It was afterward subject to Tunis till about 1510, when it was conquered by the Spaniards; and it was ceded by the emperor Charles V. to the knights of St. John of Jerusalem in 1530. In 1551 the knights were expelled by Sultan Solyman II., and the tract of country which at present constitutes the vilayet was annexed to the city of Tripoli. The celebrated pirate Dragut, who had assisted at its capture, was made the first governor, and he initiated a

system of piratical plunder which was continued for centuries. The Christian nations and their commerce were the objects of attack, and all prisoners taken were sold into slavery. The capital was bombarded by a French fleet in 1683, when the pasha professed submission to Louis XIV. A controversy with the United States grew out of the practice of piracy, and after several conflicts in 1801–'5, in which Commodores Preble and Decatur chiefly distinguished themselves (see PREBLE, and DECATUR), the latter in 1815 enforced reparation for injuries inflicted by the Tripolitans upon American commerce. In 1816 a similar mission was undertaken by a British force, which compelled the bey to renounce piracy and agree to treat all future prisoners according to the usages of civilized nations. Though Tripoli is a dependency of the Ottoman empire, the bey enters into treaties with foreign powers without consulting any superior. In early times beys were appointed from Constantinople and supported by a Turkish garrison, but a Moorish chief, Hamed Karamauli, rebelled successfully in 1713 and established himself as bey. His descendants continued to rule the country till 1832, when the last bey of the line was compulsorily removed on account of his excessive oppressions, and the Porte has since resumed its authority. The chiefs of the interior acknowledge but slight allegiance, and maintain amicable relations with the bey chiefly because the commerce carried on through the capital is advantageous to them; and the Arabs sometimes resort to open hostilities. **II.** A city (anc. *Œa*), the capital, situated upon a rocky promontory on the Mediterranean, about 600 m. S. E. of Algiers, and 300 m. S. of the Sicilian coast, in lat. 32° 54′ N., lon. 13° 11′ E.; pop. about 24,000. The land defences are a castle and wall flanked by bastions, and seaward there are strong batteries. The harbor no-

Port of Tripoli.

where exceeds five or six fathoms in depth, but the roadstead affords deep anchorage. The streets are narrow and uneven, and the houses low and irregular. They are nearly all one story high, without exterior windows, built of stones and mud, and whitewashed. Tripoli contains six handsome mosques and many others. The roof of the great mosque is formed by small cupolas, supported by 16 marble columns. There are Christian places of worship, a Franciscan convent, and several synagogues; and all religions are tolerated within the limits of the city. The pasha's residence is an immense building of very irregular appearance, constructed at different times. There are numerous caravansaries, two bazaars, and many fine public baths. Woollen goods (particularly carpets), leather, and potash are manufactured. A great part of the trade of the state, as well as that of the interior of Africa, centres at Tripoli. The merchants are principally Jews, who trade under monopolies granted by the government. There is frequent steam communication with the ports of Europe. The foreign commerce is chiefly with Malta, Marseilles, Leghorn, Trieste, and the Levant; and the land trade is carried on by means of caravans with all the surrounding countries and as far as Morocco, Timbuctoo, and Mecca. The city contains several remains of antiquity, the most remarkable of which is a triumphal arch of marble, erected in A. D. 164 to the Roman emperor Marcus Aurelius and his colleague Lucius Verus; the inscription is perfect, although the sculptures are greatly defaced.

**TRIPOLI, Tarablus, or Tarabulus** (anc. *Tripolis*), a seaport town of Syria, on the Mediterranean, in lat. 34° 26′ N., lon. 35° 49′ E., 40 m. N. N. E. of Beyrout, and 70 m. N. W. of Damascus; pop. about 16,000, one half Greek Catholics. It stands at the foot of an offset of Mt. Lebanon, on a small triangular plain, with the sea at a little distance on the N. and S. sides. A hill on the south is crowned by an old castle; and the town is divided into two parts by the Nahr Kadisha. The harbor, at El Mina, about 1½ m. to the northwest, is small, shallow, and unsafe. There are several mosques, which are generally fine buildings, most of them formerly Christian churches. It is one of the neatest towns in Syria, and is surrounded by many fine gardens and groves of orange and

other fruit trees; but the ground in the neighborhood is marshy, and the climate is unhealthful at certain seasons. It exports silk, wool, cotton, tobacco, wax, oil, cochineal, galls, soap, and especially sponges, the fishery of which occupies a large number of the inhabitants. The direct imports into Tripoli in 1869 were valued at $61,050, and in 1872 at $154,900; the direct exports, $292,425 in 1869, and $62,-959 in 1872. The commerce is chiefly in the hands of Greeks. French steamers touch here four times a month. It is the see of a Greek bishop, and the residence of several consuls. —Tripolis was an important maritime town of Phœnicia, and derived its name from being the colony of the three cities of Tyre, Sidon, and Aradus, each holding a separate quarter of it. Having been taken by the crusaders, it was in 1109 erected into a county for Raymond of Toulouse.

**TRIPOLITZA,** or **Tripolis,** a town of Greece, in the Morea, capital of the nomarchy of Arcadia, 22 m. S. W. of Argos; pop. of the demus in 1870, 11,477. It is in a plain about 2,000 ft. above the sea, and owes its name to its being the modern representative of the three cities of Mantinea, Tegea, and Pallantium, which occupied the same plain. Before the revolution it was the residence of a Turkish pasha and capital of the Morea, and had 20,000 inhabitants. The Greeks took it in 1821 and put the inhabitants to the sword; 8,000 male Turks perished, besides women and children. In revenge, Ibrahim Pasha in 1825 destroyed every house in the place. It has been partially rebuilt. The ruins of Mantinea may be seen at Paleopoli, about 6 m. N., and of Tegea at Piali, nearly the same distance S.

**TRIPP,** a S. county of Dakota, bordering on Nebraska, recently formed and not included in the census of 1870; area, about 1,500 sq. m. It is intersected in the south by the Keya Paha, and watered in the north by Dog's Ears creek, an affluent of White river. In the S. part is Turtle hill, 2,340 ft. high. It consists mostly of undulating prairies.

**TRIPTOLEMUS,** in Greek mythology, a son of Celeus, king of Attica, and Neæra, also called Metanira or Polymnia (according to another account, of Oceanus and Ge). He was born at Eleusis, and while still young was cured of a dangerous illness by Ceres, who had been hospitably entertained by his father, and attempted to render his brother Demophon (according to others, himself) immortal by burning out whatever particles of mortality he had derived from his parents. (See CERES.) The goddess taught him agriculture, and gave him her dragon chariot, in which he rode over the earth, spreading knowledge of the art. He afterward reigned at Eleusis, and was the hero of the Eleusinian mysteries.

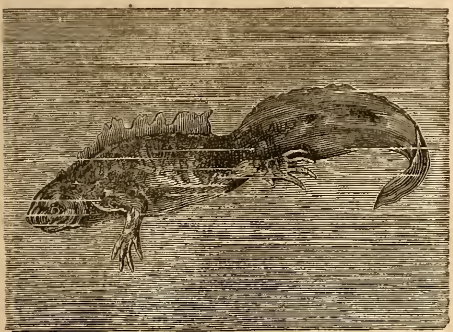
**TRIQUETI, Henri de,** baron, a French sculptor, born at Conflans in 1802, died in Paris in May, 1874. His earliest works consisted of genre and historical paintings, but in 1831 he exhibited a fine group of "The Death of Charles the Bold," and henceforth devoted himself to sculpture. His works include "Petrarch reading his Poetry to Laura," "Sir Thomas More preparing to die," "Dante in the Elysian Fields," and many busts and bass reliefs.

**TRISMEGISTUS.** See HERMES TRISMEGISTUS.

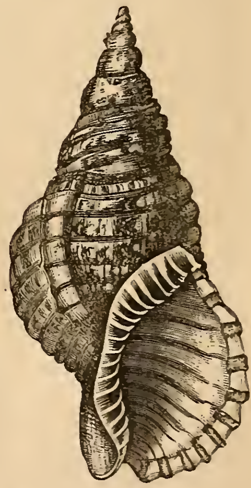
**TRISTAN DA CUNHA,** a cluster of three volcanic islands in the S. Atlantic. Tristan, the largest island, lies in lat. 37° 3′ S., lon. 12° 19′ W., about 1,500 m. S. by W. of St. Helena; area, about 40 sq. m. It is nearly circular, and rises abruptly on the N. side to an elevation of 1,000 ft. From the summit of the cliffs the land rises to a conical peak 8,326 ft. high. The surface consists of abrupt ridges covered with bushes, with deep ravines and chasms between. The summit is a crater about 500 yards in diameter, filled with water. On the N. W. side of the island is a narrow plain 100 to 150 ft. above the sea, with an excellent soil in a high state of cultivation. Near the N. extremity of this plain is a settlement which in 1870 contained 60 inhabitants, 35 of whom were children under 10 years. Nearly all are native born, the descendants of Europeans and Hottentots, with fine physique and dark skin, and are intelligent and hospitable. They have no government, disputes being settled by fisticuffs, with by-standers to secure fair play. They own a small vessel, which runs to Cape Town to exchange seal skins and oil for clothing, groceries, &c. Seals, sea lions, sea elephants, and whales frequent the group, and sea birds and edible fish abound. Heavy masses of kelp surround the shores. There are no large trees, but an abundance of shrubbery, which with sea weed and drift wood furnishes ample supplies of fuel. There is an abundance of excellent water. The climate is equable and healthy. The temperature rarely rises above 70° F. or falls below the freezing point. The only anchorage is off the N. W. point, and is very insecure.—Inaccessible island lies 17½ m. S. W., and Nightingale 20 m. S. S. W. of Tristan. The former is elliptical, 4 m. in length and 2 m. in breadth, and rises abruptly about 500 ft., the surface being flat and barren. Nightingale island is round, about 1½ m. in diameter, and 200 ft. in height. Both are uninhabited.—The group was discovered by the Portuguese navigator Tristan da Cunha in 1506, and explored by the Dutch in 1643, and by the French in 1767. Tristan was inhabited by John Patten, an American whaling master, with his crew, from August, 1790, to April, 1791, to collect seal skins. During the captivity of Napoleon at St. Helena it was occupied by British troops from Cape Town. The present inhabitants are chiefly descendants of one of these, a corporal named Glass.

**TRITON,** in Greek and Roman mythology, a marine deity, the son of Poseidon or Neptune and Amphitrite or Celæno. He had the form of a man above and that of a fish below, and bore a conch-shell trumpet.

**TRITON.** **I.** The proper name of the tailed batrachians of the old genus *triton* (Laur.), generally called newts or water salamanders; they all belong to the northern hemisphere,


Water Newt (Triton palustris).

and their species are most numerous in North America. The tail is depressed and adapted for swimming in most, though many are not strictly aquatic, but pass much of their life on the land, some visiting the water only during the breeding season; indeed, the distinction into terrestrial and aquatic species is very indefinite, species with either of these habits being found in one genus. In the breeding season, in the spring, the males acquire a fin-like fringe along the back and tail and membranous appendages to the toes; the species are difficult to distinguish on account of the varieties of sex, age, and season. Reproduction takes place by means of eggs, which are fecundated before they are deposited, and the young resemble tadpoles in form and gills. The most carefully studied species is the crested triton or water newt of Great Britain (*T. palustris*, Flem.), about 6 in. long, of which the tail is about two fifths; this species will suffice for the generic description. The body is naked, but covered with warty tubercles, and with glandular pores behind and over eyes and along sides; toes without nails, four anterior and five posterior; the dorsal and caudal crests separate; tongue slightly free on sides, and more free and pointed behind; palate with a double longitudinal series of teeth; no parotids nor glands along the back. The smooth-skinned species, without lateral pores and with a continuous dorsal and caudal crest, have been noticed under Eft. The head is flattened, nose rounded, gape large, teeth numerous and small, and the neck hardly distinct from the head and body. It is common in ponds and ditches, and one of the most aquatic of the family, swimming by means of the tail, the legs being turned back against the body; the legs are used as balancers in the water, and for a slow and feeble creeping on land; the skin comes off in shreds in the water, and is swallowed. The eggs are deposited on the leaves of aquatic plants, which are folded around them, one egg to each leaf; the parents resume a terrestrial existence in a few weeks, but the young, born in June or July, remain, according to Bell, without much change till the following spring, when they acquire legs and leave the water. In the water they are voracious, feeding on aquatic animals, insects and larvæ, the tadpoles of the frog, and even those of their own species. They are noted for their tenacity of life under mutilation and exposure to severe cold, and for the power of reproducing lost parts. They are blackish or light brown above with darker round spots, and bright reddish orange below with round black spots, and the sides dotted with white.—The many-spotted triton of the Atlantic states (*T. dorsalis*, Harlan; genus *notophthalmus*, Raf.) is about 4 in. long, of which the tail is half; it is olive or greenish brown above, with a row of circular vermilion spots on each side, and below orange studded with small black dots; eyes prominent, with flame-colored iris; posterior limbs twice as large as anterior; it is eminently aquatic, and dies soon out of water from the drying of the skin; it is torpid only in the severest weather; it is found from Maine to Georgia, forming a very lively and interesting animal for the fresh-water aquarium, and easily obtained. Several other species occur on the Atlantic coast. **II.** A genus of gasteropod mollusks of the murex family, having a conical and elongated shell, spirally convoluted. The *T. variegatum* (Lam.), 12 to 16 in. long, from the Indian seas, is the well known sea conch or trumpet of the god Triton; this species, as well as the *T. australe* (Lam.), is used by the Polynesians as a horn.


Sea Conch (Triton variegatum).

**TRIUMPH** (Lat. *triumphus*, related to Gr. *θρίαμβος*, a hymn sung in a procession in honor of Bacchus), generally, a solemn procession to celebrate a victory. The ancient Romans made the triumph a stimulus to martial exploits, and the highest military honor that could be obtained by a general, who entered the city in a chariot drawn by four horses, preceded by his captives and spoils and followed by his army, with which escort he passed along the Via Sacra, and ascending to the capitol sacrificed a bull to Jupiter. A triumph was granted by the senate to a general who had gained important successes, if he had already held one of the great offices of state; if the victory had been gained under his auspices and with his

troops; if the advantage had been positive and the number of enemies slain in a single battle at least 5,000; if it had been gained over a foreign enemy and not in a civil war; if the national dominion had been extended, and not merely recovered or relieved from the presence of the enemy; and if the war had been actually concluded so as to permit of the army's withdrawal from the conquered country. Sometimes the comitia of the tribes bestowed triumphs, and generals even triumphed in defiance of the senate and the people. Naval triumphs were also granted in some cases. After the overthrow of the republic, the emperors, in virtue of their authority as commanders-in-chief of the armies of the state, claimed the exclusive right of celebrating triumphs; and until A. D. 534, when Belisarius entered Constantinople in triumph after the overthrow of the Vandal kingdom in Africa, no subject had for more than five centuries enjoyed that distinction. This was the 350th triumph in Roman history, and the last ever celebrated. A lesser kind of triumph, called an ovation (*ovatio*) from the practice of sacrificing a sheep (*ovis*) instead of a bull, was granted to a general whose success did not entitle him to a full triumph.

**TRIUMVIRATE,** an office filled coördinately by three persons. Several magistracies of this description were recognized in the Roman government, of which the most important was that for the regulation of public affairs—*triumviri reipublicæ constituendæ*. Though magistrates with this title are thought to have been appointed as early as 360 B. C., there is no certain mention of them till toward the close of the republic. The coalition between Julius Cæsar, Pompey, and Crassus, in 60 B. C., is often called the first triumvirate, but they were never invested with any office under that title. The so-called second triumvirate of Octavius, Antony, and Lepidus (43) was the first sanctioned by the people. The office was bestowed on them for five years, and after the expiration of that term for five years more. Administration by triumvirs was apparently much favored by Roman legislators. The *triumviri capitales* had charge of the prisons and jurisdiction in minor cases; the *triumviri nocturni* had charge of the police at night. Mazzini, Armellini, and Saffi formed in February, 1849, a triumvirate at Rome, with the entire executive power placed in their hands.

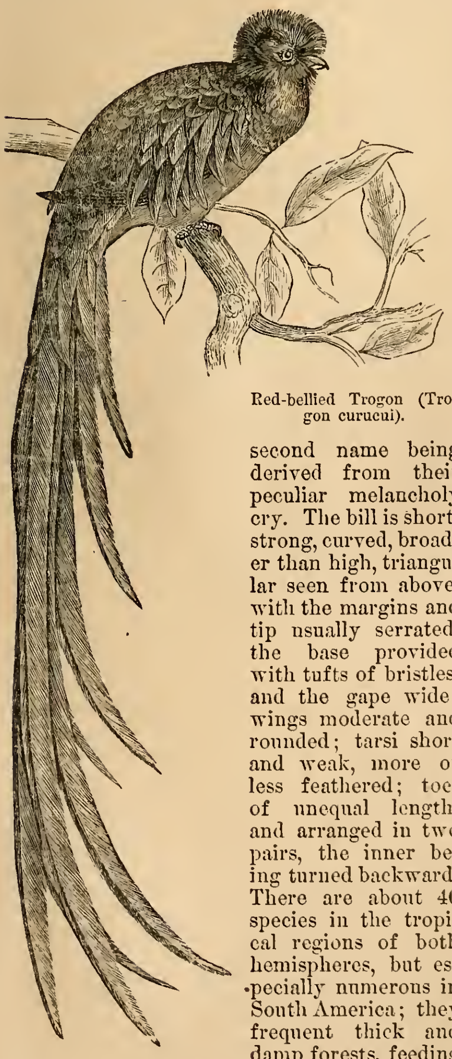
**TROCHU, Louis Jules,** a French soldier, born at Palais, Brittany, in 1815. He studied at the academy of St. Cyr and at the special military school for the staff at Paris, and graduated in 1840 as a first lieutenant. After serving under Bugeaud in Algeria, he became Saint-Arnaud's aide-de-camp in the Crimea and commanded a brigade at Sebastopol. In 1859 he distinguished himself as general of division at the battle of Solferino. In 1867 appeared anonymously his *L'armée française en* 1867 (20th ed., 1870), exposing the weakness of the military resources, which gave umbrage to the emperor. It was only after his selection by Palikao for the organization of troops at the camp of Châlons that Napoleon reluctantly consented (Aug. 17, 1870) to his being made governor and chief commander of Paris. As such Trochu ordered the expulsion of the German residents, numbering about 80,000. On the establishment of the republican government (Sept. 4) he was placed at its head. In repeated proclamations he promised the rescue of the besieged city; and when its capitulation was unavoidable, he resigned the command in favor of Gen. Vinoy (Jan. 20, 1871), though remaining at the head of the government. He attempted to defend his administration in the assemblies at Bordeaux and Versailles, of the latter of which he was a member till the spring of 1872, when he retired in consequence of the unsatisfactory issue of a libel suit against the *Figaro* newspaper, which had attacked his course. In 1873 he left the army with a pension, and he has since been engaged at Tours in writing a military work.

**TRŒZEN,** or **Trœzene,** one of the oldest cities of ancient Greece, in the Peloponnesus, in a territory named from it Trœzenia, forming the S. E. corner of Argolis. It was founded probably by the Ionians, and according to Homer was subject at the time of the Trojan war to Argos, from which it afterward received a Doric colony. Subsequently it became a prominent maritime city, founded Halicarnassus and Myndus in Caria, and probably Pæstum in Magna Græcia, and was conspicuous in the wars with Persia, its harbor being the rendezvous of the Grecian fleet after the sea fight at Artemisium. During the Peloponnesian, Corinthian, and other wars, it adhered to the side of Sparta. After the establishment of the Macedonian rule over Greece it was in the hands of various contending parties, and continued a place of some importance until the time of Pausanias, who describes its public buildings in detail; but after this period we have no account of its history. The ruins of the ancient city lie near the village of Damala, and consist principally of Hellenic foundations with Frankish or Byzantine superstructures.

**TROGLODYTES** (Gr. *τρωγλοδύτης*, from *τρώγλη*, a cave, and *δύειν*, to enter), the name given by the ancients to tribes of men who lived in caves. Several such are mentioned by ancient writers as inhabiting parts of Ethiopia, Upper Egypt, the borders of the Red sea, Mœsia, Mauritania, and the northern part of the Caucasus. The most celebrated were those of southern Egypt and Ethiopia, where a large district was called Regio Troglodytica. They are represented as depending upon cattle for their livelihood, and living in the most debased condition. In part of Arabia the mountainous regions encompassing the wadys are filled with caves, which are occupied as permanent habitations by half savage tribes of Bedouins; and it is probable that these belong

to the same race as the troglodytic population of Ptolemy and other Greek geographers. In the early history of the Christian church the name was also applied to certain heretics, who, rejected by all parties, held their meetings in caves.—In natural history, Linnæus placed the chimpanzee under the genus *homo* with the specific name of *troglodytes*, next to *homo sapiens;* and this is the *troglodytes niger* of Geoffroy and the *simia troglodytes* of Blumenbach. The term is now applied to a genus which includes the chimpanzee and the gorilla, and also to a genus of the *troglodytinæ* or wren family of birds.

**TROGON,** and **Couroucou,** names given to the scansorial birds of the family *trogonidæ*, the



Red-bellied Trogon (Trogon curucui).

second name being derived from their peculiar melancholy cry. The bill is short, strong, curved, broader than high, triangular seen from above, with the margins and tip usually serrated, the base provided with tufts of bristles, and the gape wide; wings moderate and rounded; tarsi short and weak, more or less feathered; toes of unequal length, and arranged in two pairs, the inner being turned backward. There are about 40 species in the tropical regions of both hemispheres, but especially numerous in South America; they frequent thick and damp forests, feeding on insects, fruits, and berries; they are most active in morning and evening. A few live in the islands of the Indian archipelago, and one genus in Africa. The American may be distinguished from the old world species by their barred tail. Though the neck and feet seem too short for the bulky body, the plumage is usually beautiful, often with metallic brilliancy. The eggs, two to four, are laid in the holes of rotten trees, and several broods are raised in a year. The species vary in size from a thrush to a magpie; it is rare to obtain good specimens, as they frequent the highest trees of the thickest forests, and when shot lose many of the soft and delicate feathers by the fall to the ground; the skin is very tender, and renders the operation of skinning so difficult that the natives dry the body with the feathers on.—In the genus *trogon* (Mœhr.) the first quill is short and the fourth the longest. The red-bellied trogon (*T. curucui*, Linn.) is about a foot long, green above, red below, with the throat black, and the coverts and tail striped with the same; it is a native of Mexico. The peacock or splendid trogon (*calurus resplendens*, Swains; *T. pavoninus*, Temm.) has the edges of the bill smooth, the wing coverts long and curved, and the upper tail coverts greatly prolonged, entirely concealing the tail; it is larger than the last named, and the middle tail coverts are 3 to 3½ ft. in length; it is of a beautiful bronzed and golden green above and on the throat, and scarlet below; it is found in Mexico and Central America. The feathers of this and the preceding species are much prized for ornaments. —See the "Monograph of the Trogonidæ," by John Gould (fol., London, 1838).

**TROLLOPE, Edward,** an English author, born April 15, 1817. He graduated at Christ Church, Oxford, in 1839, and became rector of Leasingham, Lincolnshire, in 1843, prebend of Lincoln in 1861, and archdeacon of Stow in 1867. He has published several archæological and architectural works, the principal of which are: "Illustrations of Ancient Art" (1853); "Labyrinths, Ancient and Mediæval," and "Manual of Sepulchral Memorials" (1858); "Monastic Gate Houses" (1860); "Life of Hereward" (1861); "Norman Sculptures of Lincoln Cathedral" (1866); and "The Norman and Early English Styles of Gothic Architecture" (1869).

**TROLLOPE. I. Frances** (Milton), an English novelist, born at Heckfield, Hampshire, about 1780, died in Florence, Italy, Oct. 6, 1863. She was the daughter of the Rev. William Milton, and in 1809 married Anthony Trollope, barrister at law. In 1829 she visited the United States, where she remained three years, residing chiefly in Cincinnati; and on her return she published "Domestic Manners of the Americans" (2 vols. 8vo, London, 1832), in which the indelicate and ridiculous phases of American character and habits were depicted. She afterward produced so large a number of novels and accounts of travels as to render her the most voluminous English authoress of the times. Her first work on America was fol-

lowed by a novel entitled "The Refugee in America" (1832), and in 1836 by "The Adventures of Jonathan Jefferson Whitlaw." About 1844 she went to Florence, where she resided till her death. Among her books of travel are: "Belgium and Western Germany in 1833" (2 vols., 1834); "Paris and the Parisians in 1835" (3 vols., 1836); "Vienna and the Austrians" (2 vols., 1838); "A Visit to Italy" (2 vols., 1842); and "Travels and Travellers" (2 vols., 1846). Some of her best novels are: "The Vicar of Wrexhill" (1837); "The Romance of Vienna" (1838); "The Widow Barnaby" (1839); "Life and Adventures of Michael Armstrong, a Factory Boy" (1840); "The Widow Married," a sequel to "The Widow Barnaby" (1840); "One Fault" (1840); "Charles Chesterfield, or the Adventures of a Youth of Genius" (1841); "Town and Country" (1847); "Lottery of Marriage" (1849); "Petticoat Government" (1850); "Young Heiress" (1853); "Life and Adventures of a Clever Woman" (1854); and "Fashionable Life" (1856). **II. Thomas Adolphus**, an English author, son of the preceding, born April 29, 1810. He has resided for many years in Florence and Rome, and has published "A Summer in Brittany" (2 vols. 8vo, 1840); "A Summer in Western France" (1841); "Impressions of a Wanderer in Italy" (1852); "The Girlhood of Catharine de' Medici" (1856); "A Decade of Italian Women" (1859); "Tuscany in 1849 and 1859" (1859); "Filippo Strozzi" (1860); "Paul V. the Pope and Paul the Friar" (1860); "La Beata" (1861); "Marietta" (1862); "A Lenten Journey in Umbria and the Marches of Ancona" (1862); "Giulio Malatesta" (1863); "Beppo the Conscript" (1864); "Lindisfarn Chase" (1864); "A History of the Commonwealth of Florence, from the Earliest Independence of the Commune to the Fall of the Republic in 1531" (4 vols. 8vo, 1865); "Gemma" (1866); "Artingdale Castle" (1867); "Dream Numbers" (1868); "Leonora Casaloni" (1869); "The Garstangs of Garstang Grange" (1869); "A Siren" (1870); and "Durnton Abbey" (1871). **III. Anthony**, an English novelist, brother of the preceding, born in 1815. From 1834 to November, 1867, he was connected with the British postal service, and he has been frequently sent abroad to establish postal conventions. He has visited the United States several times, the West Indies, Australia in 1871 and again in 1875, and other countries. In 1869 he was an unsuccessful liberal candidate for parliament for Beverly. For some time he was editor of the "St. Paul's" magazine, in which and in other periodicals several of his stories originally appeared serially. His works are: "The Macdermots of Ballydoran" (1847); "The Kellys and the O'Kellys" (1848); "La Vendée" (1850); "The Warden" (1855); "Barchester Towers," "The Three Clerks" (1857); "Doctor Thorne" (1858); "The Bertrams," "The West Indies and the Spanish Main" (1859); "Castle Richmond" (1860); "Framley Parsonage" (1861); "Tales of All Countries" (1861; 2d series, 1863); "Orley Farm," "The Struggles of Brown, Jones, and Robinson," "North America" (1862); "Rachel Ray" (1863); "The Small House at Allington," "The Belton Estate," "Hunting Sketches" (1864); "Can You Forgive Her?" "Miss Mackenzie" (1865); "Clergymen of the Church of England," "Travelling Sketches" (1866); "The Claverings," "The Last Chronicle of Barset," "Lotta Schmidt, and other Stories" (1867); "Phineas Finn, the Irish Member," "He Knew he was Right" (1869); "Sir Harry Hotspur of Humblethwaite," "The Vicar of Bullhampton" (1870); "Ralph the Heir" (1871); "The Golden Lion of Granpère" (1872); "Phineas Redux," "Australia and New Zealand" (1873); "The Way we Live now," "Lady Anna" (1874); and "The Prime Minister" (1875).

END OF VOLUME FIFTEENTH.

# SUPPLEMENT TO VOLUME XV.



**SHUVALOFF, Count Peter Andreyevitch**, a Russian statesman, born in St. Petersburg in July, 1827. He entered the army, and rose to the rank of general of cavalry (1871) without ever having held an actual command. In 1862 he was appointed director of the first chancery in the ministry of the interior, and in 1864 governor general of the Baltic provinces. When in 1866 Dolgorukoff, chief of the secret service, was dismissed from his post, in consequence of the attempt of April 16 upon the life of the czar, Shuvaloff was appointed his successor. In this capacity he immediately began to figure as one of the most prominent personages in the empire. He was soon able to reveal to the government the existence of a revolutionary movement of a magnitude little suspected, fostered by a powerful secret society, which had branches in all parts of the empire, composed of influential men and women in all ranks of society. By the sagacity and energy of Shuvaloff, many of the secret workings of the nihilistic societies were exposed, and steps were taken to put a check upon the secret propaganda which was rapidly destroying the traditional reverence of the Russian people for their emperor and the popular confidence in the government, and was paving the way for a complete social and political revolution. After seven years of strenuous exertion and unremitting vigilance in this office, failing health and the need of relaxation forced Shuvaloff to resign. In 1873 he was sent to London on a special diplomatic mission relating to the Russian military operations in central Asia. He allayed the suspicions of the English government by pledging his government not to carry the extension of the frontier beyond the right bank of the river Oxus. To secure and cement the amicable relations of the two governments, he effected an alliance between the royal families by the marriage of Prince Alfred to the emperor's only daughter. In October, 1874, Shuvaloff succeeded Brunnow, who was superannuated, as ambassador at the court of St. James's. Count Shuvaloff was the Russian plenipotentiary at the congress of Berlin in 1878.

**SIMART, Pierre Charles**, a French sculptor, born in Troyes, June 27, 1806, died in Paris, May 27, 1857. At the age of 17 he went to Paris with a pension of 300 francs a year from his native city, to carry out his cherished design of studying art, in which he had been violently opposed by his family. In 1833 he obtained the grand prize and went to Rome. In 1852 he was elected a member of the academy of fine arts. His works include "The Disk-Thrower," of which there is a plaster model at the Louvre; "Orestes taking Refuge at the Altar of Pallas," now at the museum of Rouen; "Sculpture" and "Architecture," in the Hôtel de Ville of Paris; two large figures, "Justice" and "Abundance," attached to the columns of the Barrière du Trône; "Philosophy," at the Luxembourg; "An Angel consoling Tobias;" and a "Virgin and Child," in the cathedral of Troyes. Among his best works are the bass reliefs for the château of the duke de Luynes at Dampierre. For many years he was employed on the decoration of the tomb of Napoleon I. at the Invalides, and on the ceiling of the *salon carré* in the Louvre. "Art demanding Inspiration from Poesy," a group composed in 1857, was completed from his model after his death, and placed in the Luxembourg palace. There is a collection of models of his works in the museum of Troyes. Gustave Eyriès wrote his life.

**SIMMONS, Franklin**, an American sculptor, born in Maine in 1841. His leisure time in boyhood was devoted to drawing, painting, and modelling. During the civil war he found employment in Washington, in cutting busts of statesmen and soldiers, and in the execution of several bronze statues for monuments. In 1867 he settled in Rome. His best-known

works are statues of Roger Williams and John A. King, in Washington; "Jochebed," for Mr. W. S. Appleton; "Roger Williams," in bronze, unveiled in Providence, R. I., in 1877; and the naval monument in front of the national capitol in Washington.

**SKIN, Diseases of the.** The skin, being exposed to many external irritating agents, is peculiarly susceptible to disease, and few reach old age without having experienced some affection of it. The term skin diseases is applied to those affections whose principal feature is the disorder in or upon the skin, although the disease may not be a malady solely of the structure of the skin itself. Thus *scabies* or itch consists of papules, vesicles, crusts, &c., all produced by the irritation resulting from the burrowing in the skin of a minute insect, the *acarus* or *sarcoptes scabiei*. Again, smallpox is classed as a skin disease, although the severe skin lesions are all dependent upon a poison which causes many other grave troubles. Certain other diseases, as epithelioma, are purely local, exhibiting wrong growth or nutrition of the skin; and still others are general diathetic diseases, as leprosy and syphilis. These are all reckoned among skin diseases, because they are accompanied by lesions of the skin which form an important part in their recognition and treatment. The term eruption is popularly applied to all diseases of the skin, because it was formerly supposed that every appearance on the skin was the result of some bad humor seeking to gain exit from the body. The same idea is indicated in the very old term eczema, from the Greek ἐκζεῖν, to boil over.—As skin diseases present many different features and have many different causes, their nomenclature and classification have always been a subject of much difference of opinion; and the number of names employed from ancient times to the present has always been a drawback to the understanding of the subject. Of late years there has been much more unanimity of opinion among writers and teachers as to the names to be applied to skin affections, and a desire exists to adhere to one plan of nomenclature and avoid new names. The system which has been largely adopted in all countries is to employ a Latin terminology, using the original Greek or Latin names for diseases as far as possible, and Latin terms to qualify the same when necessary. The classification now commonly adopted rests on an anatomical or pathological basis, with the addition of a single group of affections caused by parasites. The total number of recognized diseases of the skin, as shown in the classification given below, is about 100, of which at least 50 distinct forms present themselves each year in practice; the remainder are either rare or so trivial that the entire 100 varieties could all be met with only in a series of years. Only the more common forms will be noticed here. All the diseases may be grouped into eight classes, as follows: 1, parasitic affections (*morbi cutis parasitici*); 2, glandular affections (*morbi glandularum cutis*); 3, neurotic affections (*neuroses*); 4, exudative or inflammatory affections (*exsudationes*); 5, hæmorrhagic affections (*hæmorrhagiæ*); 6, hypertrophic affections (*hypertrophiæ*); 7, atrophic affections (*atrophiæ*); 8, new formations (*neoplasmata*). The names used are found in the following classification:

Class I. *Morbi cutis parasitici* (parasitic affections). A. Vegetable. 1. Tinea trichophytina (or trichophytosis), corporis (or tinea circinata), capitis (or tinea tonsurans), barbæ (or sycosis parasitica), cruris (or eczema marginatum.) (Parasite, *trichophyton tonsurans.*) 2. Tinea favosa (or favus). (Parasite, *achorion Schœnleinii.*) 3. Tinea versicolor (or chromophytosis.) (Parasite, *microsporon furfur.*) B. Animal. 1. Phthiriasis (or pediculosis) corporis, capitis, pubis. (Parasite, *pediculus.*) 2. Scabies. (Parasite, *acarus scabiei.*)

Class II. *Morbi glandularum cutis* (glandular affections). A. Diseases of the sebaceous glands. I. Due to faulty secretion or excretion of sebaceous matter. 1. Acne sebacea oleosa, cerea, cornea (or seborrhœa), exsiccata (or xeroderma). 2. Acne punctata nigra (or comedo), albida (or milium). 3. Acne molluscum (or molluscum sebaceum). II. Due to inflammation of sebaceous glands with surrounding tissue. 4. Acne simplex (or vulgaris). 5. Acne indurata. 6. Acne rosacea. B. Diseases of the sweat glands. I. As to quantity of secretion. 1. Hyperidrosis. 2. Anidrosis. II. As to quality of secretion. 3. Bromidrosis. 4. Chromidrosis. III. With retention of secretion. 5. Dysidrosis. 6. Sudamina.

Class III. *Neuroses* (neurotic affections). 1. Zoster (herpes zoster or zona). 2. Pruritus. 3. Dermatalgia. 4. Hyperæsthesia cutis. 5. Anæsthesia cutis. 6. Dystrophia cutis (or trophic disturbances).

Class IV. *Exsudationes* (exudative or inflammatory affections). A. Induced by infection or contagion. 1. Rubeola (or measles). 2. Rubella (or rötheln). 3. Scarlatina. 4. Variola. 5. Varicella. 6. Syphilis. 7. Vaccinia. 8. Pustula maligna. 9. Equinia (or glanders). 10. Diphtheritis cutis. 11. Erysipelas. B. Of internal or local origin. I. Erythematous. 1. Erythema simplex, multiforme, nodosum. 2. Roseola. 3. Urticaria. II. Papular. 4. Lichen simplex, planus, ruber, scrofulosus. 5. Prurigo. III. Vesicular. 6. Herpes febrilis, iridis, progenitalis, gestationis. IV. Bullous. 7. Hydroa. 8. Pemphigus vulgaris, foliaceus. 9. Pompholix (or cheiro-pompholix). V. Pustular. 10. Sycosis. 11. Impetigo. 12. Impetigo contagiosa. 13. Ecthyma. VI. Erythematous, papular, vesicular, pustular, &c. 14. Eczema. 15. Dermatitis calorica, venenata, traumatica. VII. Squamous. 16. Dermatitis exfoliativa (or pityriasis rubra). 17. Psoriasis. 18. Pityriasis capitis. VIII. Phlegmonous. 19. Furunculus (furunculosis). 20. Anthrax. IX. Ulcerative. 21. Ulcus simplex, venereum. 22. Onychia.

Class V. *Hæmorrhagiæ* (hæmorrhagic affections). 1. Purpura simplex, papulosa, rheumatica (or peliosis rheumatica), hæmorrhagica. 2. Hæmatidrosis (or bloody sweat). 3. Scorbutus.

Class VI. *Hypertrophiæ* (hypertrophic affections). A. Of pigment. 1. Lentigo. 2. Chloasma. 3. Melanoderma. 4. Nævus pigmentosus. 5. Morbus Addisonii. B. Of epidermis and papillæ. 1. Keratosis pilaris (or lichen pilaris). 2. Ichthyosis. 3. Cornu cutaneum. 4. Clavus. 5. Tylosis (or callositas). 6. Verruca vulgaris, senilis, acuminata, necrogenica. C. Of connective tissue. 1. Scleroderma. 2. Sclerema neonatorum. 3. Morphœa. 4. Elephantiasis (Arabum). 5. Dermatolysis. 6. Frambœsia (or yaws). D. Of hair. 1. Hirsuties. 2. Nævus pilosus. E. Of nail. 1. Onychogryphosis. 2. Onychauxis.

Class VII. *Atrophiæ* (atrophic affections). A. Of pigment. 1. Albinismus. 2. Leucoderma (or vitiligo). 3. Canities. B. Of corium. 1. Atrophia cutis propria, linearis (or striæ atrophicæ), maculosa (or maculæ atrophicæ). 2. Atrophia senilis. C. Of hair. 1. Alopecia. 2. Alopecia areata. 3. Trichorexis nodosa (atrophia pilorum propria, or fragilitas crinium). D. Of nail. Onychatrophia.

Class VIII. *Neoplasmata* (new formations). I. Benign new formations. A. Of connective tissue. 1. Keloid. 2. Fibroma (or molluscum fibrosum). 3. Xanthoma (xanthelasma or vitiligoidea. B. Of granulation tissue. 1. Lupus vulgaris, erythematosus. 2. Rhinoscleroma. 3. Scrofuloderma. C. Of blood vessels. 1. Nævus vasculosus. 2. Angioma (or telangiectasis). D. Of lymphatics. 1. Lymphadenoma cutis. 2. Lymphangioma cutis. E. Of nerves. Neuroma cutis. II. Malignant new formations. 1. Lepra tuberosa, maculosa (or elephantiasis Græcorum). 2. Carcinoma epitheliomatosum (epithelioma and rodent ulcer), papillomatosum (or papilloma). 3. Sarcoma idiopathicum, pigmentosum (or melanosis).

I. PARASITIC AFFECTIONS. These are of two kinds: those due to the growth of a vegetable organism, akin to common mould, in the outer layers of the skin, and those caused by the presence of an animal parasite. Of the former there are three varieties: *tinea tonsurans* or ringworm, *tinea favosa* or *favus*, and *tinea versicolor*. Ringworm is seen on the scalp as circular patches of disease covered with dirty scales and broken-off hair; sometimes these become much inflamed, exuding pus from the hair follicles, and this state is called *tinea kerion*. On the body ringworm appears as reddened circles with a small amount of scaling; these begin as very small spots and enlarge, with a tendency to clear in the centre. *Eczema marginatum* is the name given to an eruption occurring about the thighs and crotch, of the same nature and much the same appearances. Barber's itch, *tinea barbæ*, or ringworm of the bearded face, is the same affection, manifesting often much more inflammation; this is sometimes called parasitic sycosis. All these forms of disease are caused by the growth in and between the epidermal cells of the skin of a low form of fungus called the *trichophyton tonsurans;* this is composed of minute threads or mycelium and spores, which penetrate the outer layers of the cells of the skin and also the hairs. (See EPIPHYTES, vol. vi., p. 689.) It is their presence in the shafts of the hairs which causes them to break off in ringworm of the scalp. Favus, *tinea favosa*, or crusted ringworm, is another vegetable parasitic eruption, in which, when fully developed, small cup-shaped crusts of a sulphur-yellow color are seen. When occurring on the scalp, the common seat of it, these may be so massed together as to lose their characteristics, and only a dirty yellow mass be formed, yielding a peculiar mousy odor. On the skin not covered with hair this eruption may closely resemble ordinary ringworm; here it takes the name of epidermic favus. The parasite causing this disease is the *achorion Schœnleinii*, and it resembles very closely ordinary yeast fungus. (See EPIPHYTES.) The third form of vegetable parasitic eruption is that often called liver spots, *chloasma*, *tinea versicolor*, the *pityriasis versicolor* of older writers. This appears first and principally upon the front of the chest, in the form of brownish or fawn-colored patches of irregular size and shape, little if at all raised above the skin, and covered with a branny scaling. The smaller spots are generally circular. This eruption is entirely due to the growth in the cells of the skin of the vegetable parasite *microsporon furfur*. (See EPIPHYTES, *pityriasis versicolor*, vol. vi., p. 687.) The general appearance of the three parasites causing these three eruptions is somewhat similar, but differences can be observed under the microscope; they are best examined by scraping the surface and placing the scales or débris in equal parts of glycerine and *liquor potassæ*, and using a magnifying power of about 300 diameters. Ringworm should never be neglected, as it may spread very greatly, especially in schools. Children with it should never have their hair cut at the barbers', for the disease may be thus given to many others; also patients with "barber's itch" should use their own utensils in shaving. If left untreated, ringworm may cause permanent baldness, sometimes in patches, sometimes more or less general. Favus always tends to produce permanent baldness, and few cases escape some scars; this is also contagious. *Tinea versicolor* is a comparatively harmless affair, though sometimes it extends on to the neck and arms, and causes disfigurement, and occasionally may prove annoying by the itching produced. The treament of all these consists in the use of certain stimulating and irritating agents which are called parasiticides; they are mostly preparations of sulphur, mercury, or tar. Depilation, or extracting the hairs, is also very necessary in ringworm and favus.—The eruptions generally classed as animal parasitic affections are two, that due to the irritation produced by lice, called medically *phthiriasis* or *pediculosis* (from *pediculus*, a louse), and *scabies* or itch. (See ITCH.) Other insects, as the flea, bedbug, &c., also give rise to irritation and consequent skin lesions. Three distinct varieties of lice are found, affecting respectively the scalp, the body, and the pubis. (See EPIZOA, vol. vi., pp. 695–'6.) Sometimes these insects cause a very extensive eruption, consisting first of papules, which when scratched may result in discharging sores covered with crusts. Though they are much more common among the poor, the well-to-do are occasionally greatly afflicted with these pests. The treatment varies somewhat with the variety. On the scalp they may be destroyed with kerosene oil, infusion of stavesacre, &c. It is almost useless to attempt to remove them simply by combing and washing, for the nits or eggs cling closely to the hair, and the young hatch out quickly; but it is rarely necessary to cut the hair, although in small children there is little objection to doing so. Lice of the body are found in seams of the clothing, especially about the shoulders and waist, their eggs being also deposited there and not on the body or hairs, as in the other varieties. A warm bath, together with the proper treatment of the clothing, suffices to remove these; the clothing should be submitted for some time to a temperature of at least 212° F., that of boiling water, which surely destroys the insects and the eggs. The *pediculus pubis*, crab louse, sometimes is the long unsuspected cause of itching and eruption about the genitals. It clings very firmly to the hairs, close to the skin, and passes undetected unless it is closely searched for. One of the mercurial ointments generally suffices to remove them. The white precipitate ointment, diluted one half, is the safest remedy, as the ordinary blue mercurial ointment is apt to produce salivation. For the other parasitic disease, known as scabies, see

Itch. II. Glandular Affections have their anatomical seat in the sebaceous and sweat glands of the skin. Of these the principal are *acne*, a disease of the sebaceous glands, and *hyperidrosis*, a morbid condition of the sweat glands. —*Acne* includes the greasy condition of the skin called *seborrhœa*, the black specks seen on the face known as flesh worms or grubs, and also the red pimples or pustules observed on the face and back, forming *acne simplex*, together with the red condition, with more or less of papules, seen about the nose, cheeks, and chin, known medically as *acne rosacea*. *Acne sebacea* or *seborrhœa* is due to a wrong and often excessive secretion of the sebaceous glands. Several varieties are recognized. At times the disorder takes the form of great oiliness of the surface of the face or scalp, *acne sebacea oleosa*. Again it will be seen as a mass of greasy scales, either upon the face or in the hairy scalp; this forms a considerable portion of the number of cases presenting the condition commonly known as dandruff. Here the greasy coating of scales re-forms as often as it is removed by combing or shampoo, and is a continual source of discomfort. The disorder more commonly recognized as acne is that characterized by the presence of black specks or pimples and inflamed masses upon the face, back, and chest. The black specks are known as *acne punctata*, or *comedo* (plural, *comedones*); they consist of distended sebaceous glands filled with hardened plugs of sebaceous matter. This may be forced out by squeezing the black specks between the thumb nails, or by forcing a watch key down upon them, or by means of a little tube made for the purpose, with a very small opening. By this means a yellowish plug of varying length is extruded, whose outer end is black from contact with the air. This plug is composed of sebaceous matter, epithelial cells, and minute hairs; and occasionally there may be found in it a minute animal parasite, the *demodex folliculorum*, called also *acarus* or *steatozoon folliculorum*. (See Epizoa, vol. vi., p. 694.) It is not thought that this animalcule has anything to do with the disease, for it is not found in every comedo. The size and shape of the plug and its blackened extremity have given rise to the popular impression that this is indeed a worm; hence the popular expression of "skin worms," or "grubs." The natural termination of these comedones is for them to cause inflammation, resulting in the pimples or pustules of ordinary acne. There is no harm in removing them artificially, though this is not curative; for if the cause remains, they will reappear as often as removed. The cause of the various forms of acne is undoubtedly debility, both general and local, and very commonly errors of digestion and assimilation can be readily detected. The treatment should always be directed to removing such known causes as constipation, dyspepsia, and debility, and may include a very large number of remedies: there is no specific for acne. The local applications largely contain sulphur and various stimulants to the skin. The avoidance of soap is undoubtedly one cause of the blocking up of the follicles, and the proper use of a good, non-irritating soap will do much toward keeping the face free from acne. Young people are especially inclined to have acne, and there will frequently remain a tendency to relapse until manhood or womanhood is established.—*Hyperidrosis* signifies an excessive secretion of sweat, and is sometimes a very annoying and obstinate disease. When affecting the palms of the hands, it renders them clammy and disagreeable to touch, and may even cause them to be tender; it sometimes affects the soles of the feet to such a degree as to make walking very painful. Sometimes one part of the body will sweat greatly, as the armpits; or occasionally we have excessive sweating of one side of the body; and often we have the general sweating, excessive especially at night, seen in phthisis and other debilitating diseases. The secretion of the sweat is under the control of the nervous system, and such cases generally exhibit more or less positive signs of nervous weakness. Belladonna and atropine are the most successful agents in arresting sweating, but they are so powerful that they should only be employed under medical guidance. *Bromidrosis* is the term applied to offensive sweating; *chromidrosis* to certain cases where the sweat has a peculiar color, sometimes bluish or yellowish. III. Neurotic Affections, or Neuroses, are such as show a decidedly nervous element or cause. The most prominent of these is *zoster*, *herpes zoster*, or shingles. This takes the form of flat vesicles or water blisters in groups, always following the track of a nerve. The peculiarity of this eruption is that it is limited to one side of the body, for the reason that the nerves pass from the central organ, the brain or spine, to either side, and do not cross to any extent in front. This accounts for the popular impression that if the eruption of shingles extends all around the body, the patient will die. The eruption cannot go around, because it follows only the distribution of the nerve whose disease or inflammation causes the skin lesion, and that is distributed only to one side of the body. But if two opposite nerves are thus affected, the eruption may extend around the body, and this has been observed without fatal result. There is sometimes very great neuralgic pain with zoster, both before, during, and occasionally for months after the eruption.—*Pruritus* or itching is another neurotic affection of the skin, though it is far more commonly only a symptom of other diseases; thus we have intense pruritus in eczema, prurigo, scabies, &c. As a separate affection, without any skin lesions except those caused by the scratching, it always indicates some systemic disorder, and may give very great distress. One form of it is known as *pruritus hiemalis*, or winter itching, which comes on with the cold weather; this affects

principally the back of the shoulders and arms, also the thighs and calves. The itching is worse after undressing at night, and sometimes renders sleep impossible. The irritation from underflannels has undoubtedly some share in the trouble, and the skin often has to be protected from them; but there is also frequently present the state known as *oxaluria*, which requires medical attention. Local applications are only of partial service, but give some measure of relief. A wash with two or more teaspoonfuls of bicarbonate of soda in a pint of water relieves the itching somewhat; also an ointment of five to ten grains of carbolic acid to an ounce of cosmoline or vaseline. Pruritus of the genitals is occasionally very distressing; but as it is more commonly but a sign of other disease, sometimes of diabetes, its treatment cannot be given here. IV. Exudative or Inflammatory Affections. No fewer than 31 skin diseases are found in this class. First there is a group of diseases induced by infection or contagion, embracing those commonly known as the exanthemata. For these see Measles (or rubeola), Scarlet Fever (or scarlatina, under Fevers), Smallpox (or variola), Chicken Pox (or varicella), Vaccination (or vaccinia), Erysipelas, Glanders, and Malignant Pustule. —*Syphilis* is a disease caused by the entrance of a specific poison into the system, where it produces a variety of changes which may affect every organ and tissue of the body. The original source of the contagious principle has been the object of much study and controversy, but as yet very little is known. Its first appearance among the nations of Europe is generally believed to have been about the time of the discovery of America by Columbus. There is also great difference of opinion in regard to the origin and meaning of the name syphilis. It has always been looked upon as a venereal disease, because by far the most common mode of acquiring it is by impure contact; but it is now known to have been communicated in so many different ways, that it no longer can be always regarded as a venereal disease; many are now suffering from syphilis who are quite as innocent of its acquirement as is the child who contracts measles or scarlatina. Thus, certain cases have been reported where the disease was given by vaccination, and also in the rite of circumcision, and in tattooing the skin; other series of cases are recorded where glass blowers have contracted syphilis from passing the pipe used in their occupation from mouth to mouth, and this has occurred from smoking pipes and from cigars; in other cases the poison has been left on various utensils; and again many surgeons and midwives have contracted the disease on the fingers in the honorable discharge of their duties. When infection has taken place, there is developed, at the point where the poison gained entrance, what is known as a chancre, or the initial lesion of syphilis. This is often an insignificant affair, sometimes giving very little trouble, and secreting but little matter, so that it is even overlooked; at other times it is large and swollen, and causes much distress. There is a peculiar condition commonly found in this sore, called induration, a term which has reference to a certain hardness of the base of the sore, it feeling almost like a piece of cartilage. Associated with this hardening of the base is also an infection of the neighboring lymphatic glands, so that they appear as kernels of various sizes beneath the skin, quite movable and generally painless. There is another kind of sore which is named chancroid (like a chancre), or called by some a simple chancre or non-infecting sore, which occurs under similar conditions, and at times greatly resembles the initial lesion of syphilis, but has no connection with or relation to it; it is simply a local, contagious sore, which does not infect the system, and so is not followed by any of the signs of syphilis. The term constitutional syphilis is applied to the state produced by the action of the syphilitic virus; the symptoms present may be most varied, and at times most puzzling; every organ of the body is liable to be affected in some way or at some time, although in the majority of instances the main manifestations occur upon the skin, and it may almost be said that no case of syphilis escapes without some cutaneous disorder. The term secondary syphilis usually refers to some of the symptoms during the earlier years after infection; and tertiary syphilis represents later lesions, which are more commonly confined to the bones, nervous system, &c. No sharp line, however, can be drawn where the one ends and the other begins. Thus far only what is known as acquired syphilis has been referred to—that is, that form of the disease in which the individual acquires the syphilis by inoculation at some period after birth. Hereditary or inherited syphilis has certain differences from this. It is gotten from either parent, in the same manner in which epilepsy, consumption, and gout are inherited, and as a consequence we have not the first stage, the initial lesion or chancre; the eruption manifests itself on the skin some weeks or months after birth, or the infant may be born with marks of the disease already developed. Prominent among the signs is a certain form of sore mouth, somewhat resembling thrush, which is contagious, and from which healthy persons are occasionally inoculated, the point where the poison enters becoming a chancre. Wet nurses have thus acquired syphilis from diseased infants, and have in turn transmitted it to others not previously infected. Care should be exercised in selecting wet nurses, and a medical examination should be made, for cases have occurred where very serious results have happened by the introduction of disease by this means. The healthy cuticle is a protection against the entrance of this and other poisons, and where inoculation has taken place it can very frequently be traced to some previous break in the skin, as a cracked lip, a fissured

nipple, a cut or wound on the finger of a physician or midwife, &c. The chancroid, being a local disease, is cured by local means, and when healed the disease is at an end. The treatment is mainly by caustics, the hot iron, &c., together with cleanliness. The prognosis of syphilis is more serious, and this disease should never be slighted; for if neglected it is capable of producing the most serious results, as the loss of eyesight, terrible nervous disorders, paralysis, &c., and it even destroys life. If taken well in hand with intelligence and knowledge, it is not to be feared; for in by far the larger number of cases it is manageable, and the symptoms can be removed and held entirely in check. In regard to its complete cure or eradication, a certain number of cases tend to get well, and the patient suffers comparatively little from his disease; while in many others, if unchecked, it goes on from bad to worse. But prolonged treatment does afford immunity from attacks, and most authorities believe that syphilis is ultimately curable; a complete cure cannot, however, be pronounced until a considerable period of time has elapsed without any symptoms. An average duration of treatment (which should be regularly interrupted) is about two years from the beginning of the course. The antidote to syphilis is undoubtedly mercury, which if properly used is capable of greatly benefiting the health while it removes the symptoms. In regard to the popular fears as to mercury remaining in the system, they are utterly unfounded, as far as relates to the intelligent medical use of the drug to-day. In spite of the various attacks upon it, it still constitutes the sheet anchor of treatment with those who see most of the disease and understand it best. Another remedy, iodide of potassium (also iodides of ammonium and sodium), is of great value, especially in the later forms of syphilis; but it is questionable if this does more than remove the lesions, while mercury controls the disease. Gold has been highly praised as a remedy in syphilis, in place of mercury, and there is some reason for belief in its efficacy. Still other remedies—indeed, very many—may be required from time to time, to meet the various forms of the disease and the prostration of the system which it causes.—A large proportion of the more common inflammatory disorders of the skin are also included in this class, such as eczema, lichen, herpes, psoriasis (see Lepra), urticaria (see Nettle Rash), erythema (see Erythema), furunculus (see Boil), &c.—*Eczema* exhibits so many features and phases that it is impossible to describe it briefly so that it can always be recognized. It is a distinct disease, separate from all others, and is not, as many suppose, a generic term for disorder of the skin. It is an inflammatory affection, characterized by redness and itching, with exudation from the blood vessels, which in the more acute forms may appear on the surface in vesicles or pustules; or, if the surface be broken, it exudes as a sticky secretion; or, in more chronic states, the exudation is retained in the meshes of the skin and causes thickening of the integument. The extent of the eruption may vary from a very small red patch, giving comparatively little annoyance, even to the extent of covering the entire body. Itching is always a characteristic symptom, which may be so severe as to drive the patient almost frantic, and often such as to prevent sleep for long periods. Eczema attacks both sexes about equally, and all ages. It is by far the most frequent of all diseases of the skin, and forms at least one third of all cases collected in statistics. It is most commonly seen in infancy, where it takes the name of "milk crust." Formerly it was supposed to be in some way connected with the taking of milk by the infant, whence its name, but is now known to occur under many different conditions. The same eruption later in life goes by the name of "tooth rash," and the irritation produced by the cutting of each tooth may be followed by a new eruption. But this is not the sole cause, and infants affected with it can be treated so that neither the milk nor the teeth will cause it to appear. There is absolutely no harm in curing eczema, but, on the contrary, if proper dietary, hygienic, and medicinal treatment is carried out, the sufferer will be improved in health while the eruption is cured. The most common locations for eczema are the face and head and the flexor surfaces of the extremities, as the bends of the elbows and knees, the genital region, &c. The hands are also very frequently the seat of the disease, and it may prove very obstinate there, also on the face and about the ankles. When it occurs in the joints it gives rise to very painful cracks or fissures, which may render the hands almost useless. The eruptions known as "washerwoman's itch," "bricklayer's itch," "grocer's itch," and "baker's itch" are eczema caused by the irritating action of soap and water, soda, mortar, &c. Barber's itch, as already mentioned, is quite a different affection, caused by a vegetable parasite, and always acquired by contagion. Eczema often has a local cause for the particular outbreak, but there is a constitutional state back of this which is as yet imperfectly understood. It is undoubtedly one of debility, but there is also something more. The secretions are apt to be deranged in eczema; constipation is very common, and the urine often presents changes, shown by the presence of the urates and oxalate of lime. In other words, there are certain signs of imperfect elaboration of food, and of imperfect removal of waste products, which are as much a part of the disease as is the local trouble on the skin. The treatment of eczema, therefore, should be threefold: first, removing or abstaining from the exciting cause of the outbreak; second, the proper protecting of the diseased parts; and third, suitable medical constitutional, dietetic, and hygienic treatment. Sometimes we have to do the two latter while the

first cannot be accomplished perfectly, as when the patient depends upon an occupation which is in part a cause of the eruption. Even here, however, we have reason to believe that if all else were quite right the occupation might be harmless to produce trouble; thus, many washerwomen, plasterers, &c., have no skin difficulty, and the individuals affected often carry on the occupation for a long time without ill effects, until some systemic cause arises; and, furthermore, they may return to the same occupation when restored to health and remain free from the eruption. Not even an outline of the treatment which is of service can be given here, for it must vary with each case. When there is an acute inflamed surface the coverings must afford protection and be non-irritating, whereas in more chronic forms very considerable stimulation may be required to remove the disease. In like manner the internal treatment must vary with the conditions present. Arsenic is very commonly required, but is not universally beneficial, and should only be administered by medical advice. In the more acute forms of the eruption it will often be found to do positive harm, increasing the disease. When given medically, arsenic is perfectly harmless; it does not remain in the system, and there is no such thing as a chronic arsenical poisoning occurring from its use as a drug.—*Lichen* much resembles eczema in many of its features; but the characteristic of the eruption of lichen is, that it is always composed of separate red points, or papules, which may run together somewhat, but which never coalesce to form the moist surfaces seen in eczema. There is no exudation or oozing in lichen, unless it has been very greatly scratched or torn, when there may be some inflammatory exudation; but this has a strong tendency to cease and to dry up, whereas in eczema the tendency is the other way. We may have a papular eczema which resembles lichen very closely, and the diagnosis between the two may sometimes be in much doubt. Lichen as a rule attacks the extensor surfaces of the body like psoriasis (see LEPRA), whereas eczema chooses the softer skin of the flexor surfaces, as at the bend of the elbows, knees, &c. The causes of lichen and its treatment are much the same as those of eczema.—*Prurigo* is another papular eruption belonging to this group. Here the papules are larger, more apt to be of the color of the skin except when scratched, and consequently may often be felt by the finger when hardly visible externally, as small shot-like elevations beneath the skin. Its favorite seat is over the front surface of the lower legs and thighs, also later the forearms, arms, and body. It is rare in this country, but not very uncommon in Germany. It is well nigh incurable, and the itching attending it when fully developed is most intense. It is not contagious, and is most common among the poor and ill cared for.—*Herpes*, *hydroa*, *pemphigus*, and *pompholix* are affections of the skin characterized by the formation of large vesicles and bullæ, or water blisters, filled with a clear fluid (serum). They differ somewhat from each other, but possess the feature in common of more or less flattened elevations of epidermis containing a yellowish fluid, with comparatively little inflammation around. The most common form of these lesions is *herpes zoster* or *zona*, popularly known as "shingles," which has already been described as a neurosis, because its definite cause is the inflammation of the nerve (and its ganglion) distributed to the affected region. *Pemphigus* is a more dangerous affection; here the blisters are apt to be much larger, even up to the size of half a hen's egg; they appear irregularly over the surface, are always attended with great debility, and the patient may die of the disease. The real cause of pemphigus is unknown; it is undoubtedly due to nervous disorder, and the one remedy which has most control over it is arsenic administered freely. —There are five affections belonging to this class which are characterized especially by the production of pus: these are sycosis, impetigo, ecthyma, furuncle (see BOIL), and anthrax (see CARBUNCLE). *Sycosis* is an inflammation of the bearded face, characterized by the presence of small pustules around the hairs, with more or less inflammation between. It consists of a deep-seated inflammation around the follicles, so that when the pus or matter reaches the surface it has traversed the length of the hair follicle, and the hair stands loose as in a well of pus, and can be extracted almost without pain. The disease commonly called "barber's itch," or parasitic sycosis, is really a *tinea* or ringworm of the beard, caused by the presence of the vegetable parasite *trichophyton tonsurans*, as described under the first group of diseases; sometimes this causes much inflammation, and the condition is very similar to true sycosis. This latter, however, is quite a different disease, not at all contagious, but due to internal causes and closely allied to eczema. *Impetigo* is a pustular eruption affecting any portion of the body, made up of separate small collections of pus or matter on inflamed bases; these, if not irritated, last but a few days, dry into a crust, and disappear, leaving no scar. Older writers gave the name of impetigo to many cases which are now recognized as a pustular eczema, the pustular element resulting from a low or scrofulous state of the system; this form of eczema takes the name of *E. pustulosum* or *impetiginosum*. *Ecthyma* is much the same process as impetigo, except that its elements are larger, more inflamed, with a larger and deeper base and crust, and generally leave a scar. The eruptions caused by scabies or "the itch," and also by *pediculi*, may be impetiginous or ecthymatous. Furuncles or boils and carbuncles are but the same process, only a still deeper and larger amount of tissue is involved, and there is a central slough or portion of dead skin, the "core," after the re-

moval of which they heal. All these states characterized by the presence of pus are indicative of greatly lowered vitality, and powerful tonics are always demanded.—Several forms of ordinary inflammation of the skin are recognized by dermatologists under the name of *dermatitis*. These are: 1, *dermatitis calorica*, where the irritating agent is heat or cold (see Burns and Scalds, and Chilblain); 2, *dermatitis venenata*, or inflammation produced by poisonous agents, which may be vegetable, as in the case of poison ivy and poison sumach (see Sumach), or from various agents and dyes, as in certain highly colored woollen goods, socks, &c., or by croton oil, tartar emetic, arnica, megereon, or mustard; 3, *dermatitis traumatica*, where the inflammation is due to mechanical injury. The state of the skin varies in these cases according to the nature and the severity of the inflammation, and the treatment is based on surgical principles, being soothing and protective. The treatment of burns with bicarbonate of soda is now accepted as of great service, and consists of a solution of a few teaspoonfuls of the bicarbonate in a pint of water, kept continually applied. V. Hæmorrhagic Affections. This group comprises purpura, hæmatidrosis (or bloody sweat), and scorbutus (see Scurvy). *Purpura*, or "the purples," is characterized by the appearance beneath the skin of small purplish spots of various sizes and shapes, more often round, caused by the effusion of blood or of its coloring matter into the texture of the skin. These spots may be slightly raised at first, but as a rule are on a level with the skin, and present the peculiarity as distinguished from other eruptions that they do not disappear at all on pressure. Other red eruptions, due to congestion or inflammation, are caused momentarily to disappear or to become much less marked when the finger is pressed upon them and quickly withdrawn; but with the stains of purpura and scurvy this does not occur. The most common place for purpura to appear first is just below the knees, or at the ankles; later it affects the forearms, and in severe cases much of the body may be covered. The spots usually appear in crops from day to day; and as the individual ones last about a week before they are absorbed, they may usually be observed in all stages, from the brighter red or purple ones of to-day, through the more brownish ones of yesterday, to the faintly marked greenish-yellow stains a week old. *Purpura hæmorrhagica* is the same affection in a very much more aggravated degree, in which there are hæmorrhages from the mouth, nose, stomach, bowels, kidneys, &c.; and unless relief is obtained, the patient dies. The treatment of purpura should be tonic and addressed to the nervous system. Iron, strychnine, quinine, and cinchona bark are all of great service. Ergot is most to be relied upon for checking the hæmorrhages and really arresting the disease, and should be given in very full doses; turpentine is also of great repute for this purpose. *Purpura rheumatica*, or *peliosis rheumatica*, is characterized by hæmorrhages in the skin; but it exhibits also certain rheumatic elements which go to place it rather as a papular erythema, and it is little influenced by ergot, but generally controlled by quinine. *Hæmatidrosis*, or bloody sweat, is a very rare affection, but has been sufficiently attested to be believed in by dermatologists. It consists in the oozing from the pores of the skin of a bloody-colored fluid, which comes from rupture of or transudation from the blood vessels connected with the sweat glands. It is due to intense nervous prostration, and is related to purpura and treated by the same remedies. VI. Hypertrophic Affections. In this class are included 21 diseased conditions, grouped under the different elements of skin affected, and each characterized by hypertrophy or unnatural increase of the portion of the skin forming its seat. *Lentigo*, or freckles, consist of deposits of pigment of varying size in the deeper layers of the cuticle, next to the papillæ, and cannot therefore be removed by measures which simply affect the outer hard layers. Freckles appear to be owing to the action of the sun, but it is thought that this is not always so, because they are also found on parts of the body which are not exposed to sunlight, and many are troubled with them quite as much in winter as summer. *Chloasma*, or moth (called also liver spots), is similar to lentigo, but the staining is in larger patches and is of a deeper brown. It is seen especially on the forehead and cheeks, also on the chin, and sometimes on the lips, as a brownish discoloration, with sharply defined edges, level with the skin, smooth on the surface, without scales, and apparently indelible. The seat of the pigmentation is the same as in lentigo; the causes are still somewhat obscure, though it seems certain that both disturbances of the liver and diseases of the female sexual organs can give rise to it. There are many lotions, &c., advertised surely to remove these moth patches; suffice to say, that they do not accomplish their end, and if the discoloration is removed, it is quite likely to return if the cause is not removed as well. Most of the remedies for the removal of these pigmentary diseases contain mercury, which is perfectly safe if used under proper medical guidance. Another hypertrophy of the coloring matter of the skin is the so-called mole, *nævus pigmentosus*, the pigment birth marks or mother's marks. These consist of brownish patches of various size and shape, often quite large, which may be more or less raised above the level of the skin. When hairs grow from them, they take the medical name of *nævus pilosus*. There is another form of nævus, called also mother mark by the laity—namely, the vascular nævus, vulgarly called claret stain or port-wine mark. This may at times cause a hideous deformity in the large extent of deeply colored skin, occupying, for instance, a large part of the face. It is due to an enlargement

and multiplication of the capillary blood vessels, which otherwise should be invisible. There are many foolish popular opinions in regard to the causation of these so-called birth marks, and many foolish popular prejudices against their removal. One will often be told that his mother while pregnant was frightened by a mouse, for instance, and that as a result the brown stain came on the child; or, that she spilled some claret, or in eating strawberries or raspberries stained the corresponding part of her own person, and the red stain came on the child as a consequence. Such stories belong to the age of mysticism in medicine, and with more enlightenment will pass from the popular mind. The prejudice against the removal of these deformities is quite as groundless. There is no sensible objection to it except the difficulties inherent in the procedure. No washes or mere local applications will be of any use, and surgical interference is alone of service. The smaller nævi may be excised, and even the larger pigmentary nævi have been removed successfully piecemeal, without leaving much scar. The vascular nævi, or claret stains, may also be removed surgically in several ways: they may be treated by the introduction of needles and the passage of an electric current through them—electrolysis; or a hot instrument may be employed to burn them superficially. Other methods have been proposed and employed with varying success; as, making multiple cuts across the vessels in such a way as to cut off the circulation, or accomplishing the same end by repeated pricking with a bundle of needles dipped in carbolic acid, much as in the process of tattooing. All methods of removal of these deformities are followed by more or less scarring, but if well done the disfigurement is much less than that occasioned by the original disease; the last procedure is perhaps attended with the least cicatrix.—The next group, of six diseases, where there is hypertrophy of the epidermis and papillæ, has its chief interest in *ichthyosis* or the so-called fish-skin disease. The resemblance to fish scales (ἰχθύς, a fish) is more fancied than real, though some cases exhibit a very curious checkered scaling strongly suggestive of a fish. The skin is harsh and dry, seldom perspires, and the patient is continually sensitive to cold, and in winter may suffer very much. In some cases the epidermal thickening becomes very considerable, and may even stand up in masses which have suggested a resemblance to spines; and such cases have been exhibited under the name "porcupine men." Mild cases of this very curious affection in one or another form are not very uncommon. The disease is well nigh incurable, although much may be done to mitigate the suffering of severe cases, or to allay the annoyance of lighter ones, by means of alkaline and steam baths and the subsequent and continual use of greasy matter to the skin. It is a disease of childhood, and rarely if ever develops for the first time late in life; children are occasionally born with it. It should always be treated when it first appears, and that faithfully and persistently; for it is only in childhood that we can hope to arrest the diseased skin formation, and cases long neglected seldom if ever return to perfect health. —Hypertrophies of the connective tissue embrace several very interesting diseases, which may be briefly mentioned. *Scleroderma*, or hide-bound skin, is a condition in which the skin becomes hardened until it resembles tanned sole leather, when it contracts and binds down the part with a vise-like grip, to such a degree as even to cause absorption of the muscles beneath. More generally this occurs in patches or streaks, as down a limb; sometimes it involves the whole limb, and the member is hard, stiff, and contracted; or again it may attack the chest, when the contraction of the skin so hinders breathing that great distress and even death may ensue. *Sclerema neonatorum* is nearly the same affection in infants, where almost the entire surface may become involved in a process of hardening, beginning on the lower extremities and extending upward. It may appear early in infancy, or be congenital. It is generally fatal. *Morphœa* refers to cases where there is one or more spots of hardened tissue, somewhat resembling that of scleroderma, but having certain differences from this: the edges of the patches are usually sharply defined, and may be readily detected by the feel; there is a purplish or lilac border around each patch; and there is not the tendency to extension over a larger surface, or to contraction of the affected portion of skin, resulting in deformity or annoyance, shown in scleroderma. In all these three affections the diseased skin has a hard, brawny feel, and cannot be pinched up as can healthy skin. The causes of these alterations are suspected to be nervous in origin, while the real essence of disease may lie in the lymphatics. Not very much can be accomplished medically, though some cases yield fairly well to electricity. *Elephantiasis Arabum* has already been described in a separate article, in connection with leprosy, which latter was formerly called *elephantiasis Græcorum;* the two diseases are entirely distinct from each other. (See ELEPHANTIASIS.) — Hypertrophy of hair, *hirsuties*, sometimes is the cause of great annoyance, especially on the face, arms, and neck of ladies. Occasionally it attains remarkable proportions, as in the cases of the so-called bearded women, where the entire face will be covered with a beard as perfect and complete as a man's. Such cases have been observed medically with great care, and the subjects are found to have the attributes of women, and a recent instance of some note was the mother of several children; usually, however, it is asserted that females with such beards appear quite masculine in the voice, form, &c. These cases are of course only medical curiosities, and no attempt at relief could be reasonably made. But when hair grows to

a moderate extent on the face, especially about the chin and upper lip, medical skill can offer relief from the deformity. Many remedies are advertised under the name of depilatories for the removal of these obnoxious growths, but from the nature of the case they are and must be useless for permanent relief. The hairs reach down through almost the entire depth of the skin, and are firmly imbedded in the hair follicles. At the bottom of each follicle there is a minute projection, known as the hair papilla, from which the hair is believed to take its growth. As long as this papilla and the bottom of the follicle remain intact, and possessed of nutritive power, hair will be formed, which is pushed to the surface and beyond by the newly developed portion beneath. When the hair is extracted, this papilla is still left; and if the person be in health, a new hair is formed and soon appears at the surface. This is observed practically when the hairs are extracted in the case of ringworm. It is useless therefore to attempt to get rid of these encumbrances by simply pulling them out, for the follicle is stimulated thereby, and greater growth ensues. The "depilatories" which are warranted to remove the hair consist of corrosive substances, such as quicklime and baryta; and the directions are to make them into a paste with water, to apply this to the skin for a few moments, and then to scrape the surface with a dull instrument, as a paper-cutter. Now, what has been done? Exactly the same as is accomplished when a man shaves, except that the paste softens the hairs more than the soap does, and the shaving is therefore done with a blunt instrument instead of a sharp razor. But neither prevents the regrowth of the hair, although the paste perhaps softens it to a little distance below the surface, and it does not grow again quite so quickly. Certain diseases, as sycosis and others, reach down and destroy the whole follicle and the papilla, and may be followed by baldness; and this method must be imitated medically if permanent removal of superfluous hair is desired. Occasionally one sees on the chins of ladies small black marks where they have attempted thus to destroy the follicle by thrusting a hot needle into it, and a small portion of soot from the blackened needle has been deposited beneath the skin, forming an indelible tattoo. The plan has been proposed, and successfully carried out, of introducing a fine three-cornered needle into each follicle, deep enough to penetrate the papilla, and then by a few rapid twirls causing its destruction and an inflammation of the follicle, which effectually precludes the new formation of hair. The same may be accomplished by introducing the needle and then attaching it to the negative pole of a galvanic battery, while the positive pole is held in the hand; electrolytic action then takes place around the needle, the hair is loosened, and the follicle is so altered as to cease to produce hair. Both of these methods are successful in only a certain proportion of the hairs operated upon, because of the great difficulty of so introducing the needle and completing the operation that the papilla and bottom of the follicle shall be destroyed. Both procedures are moderately painful. VII. Atrophic Affections. This class comprises those diseases which are characterized by atrophy of one or more elements of the skin. The most interesting are those in which the pigment of the skin undergoes changes or is found unnaturally distributed. These cases are known as *albinismus* and *leucoderma* or *vitiligo*. Albinismus is the term applied to those cases popularly known as albinos, where the pigment or coloring matter of the body is deficient, and as a consequence we have a white waxy skin, white or very light-colored hair, and pink eyes from the want of coloring matter in the eyes. (See Albinos, and Complexion.) Leucoderma or vitiligo is characterized by the presence of pretty sharply defined patches of whitened skin surrounded by a surface somewhat darker than natural. These light spots are generally of a roundish outline; they appear small, and gradually enlarge until a considerable surface may be affected. They usually come quite symmetrically, as on the backs of the hands or fingers, or on both sides of the neck. They are generally worse in summer than in winter; they may disappear entirely and return again, and are very rebellious to medical treatment. —*Alopecia* or baldness may be due to many different causes. When the falling of the hair is owing to acute sickness, and when it falls early in syphilis, it grows again quite readily. The hair also grows well after eczema of the scalp when the disease is cured. When, however, it is the result of seborrhœa, or of pityriasis capitis, it is much more difficult to cause a new growth of hair; and in persons with hereditary tendency to baldness it is almost impossible to prevent its loss. The various hair restoratives are based on the idea of stimulation to the scalp; but as there is often some cause for the falling, such as nutritive debility, their effect is necessarily transient. General tonics and measures calculated to improve the health will often do more to arrest the falling of the hair, and promote its regrowth, than any advertised nostrums. There is reason to believe that the use of very fine white flour instead of that made from the whole wheat is one cause of the prevalence of baldness. *Alopecia areata* is a peculiar affection where the hair falls only from localized patches, which then appear smooth, white, and shiny.—*Trichorexis nodosa* is a curious alteration in the hairs, whereby small node- or knot-like swellings are formed, like beads, on the hairs especially of the face, at which nodes the hairs have a great tendency to break, leaving a frayed-out, brush-like end. Sometimes there will be many of these minute swellings on the hairs. It is not a parasitic disease, but is due to altered growth of the hair. The treatment is by repeated shaving for a time, with the subsequent application of an oily sub-

stance. VIII. NEW FORMATIONS, OR NEOPLASMATA. In this group, in which there is a new development of disease elements not caused by inflammation, 14 distinct diseases are included. —*Keloid* relates to a fibrous growth in the skin which much resembles that resulting from a wound or a burn. The peculiarity of the true keloid is, that it has a tendency to spread or increase, and there arises a reddish elevation, firm in structure and irregular in outline, with finger-like prolongations reaching out from it. Little can be done for these growths, and the general medical opinion favors non-interference with them, as they give but slight annoyance, and if left alone will not cause further harm; moreover, attempts at removal by caustics or the knife have very frequently been followed by recurrence of the growths, and even their increase.—*Fibroma* is the name given to circumscribed growths of fibrous tissue in the skin, giving rise to small tumors of various sizes, generally round, often pedunculated, but frequently also sessile. Sometimes only a single tumor will be found, but sometimes they multiply to an amazing number; and over 3,000 growths of this form, of various sizes, have been counted upon a single individual. They are perfectly harmless, and give no annoyance except by their presence; they can be completely removed surgically, and without much difficulty, except of course when their number is very great. Occasionally this overgrowth of the fibrous structure of the skin attains enormous proportions, and the tumors may weigh many pounds.—*Xanthoma*, *xanthelasma*, or *vitiligoidea* is a new growth characterized by the development of yellowish or light fawn-colored patches of limited extent in the skin, most commonly about the eyelids. The surfaces of these patches are generally slightly raised, but sometimes the elevation may be considerable. The surface of the diseased portion has a soft velvety feel, and may be pinched up, showing a moderate amount of thickening. They cause little or no annoyance, and advice is sought chiefly for cosmetic reasons. They can be removed by excision, and if but a small portion is cut out at a time the resulting scar may be trifling. Strong evidence has been adduced to show that this state is due to disturbances of the liver action, but high authorities also maintain that there is no such connection.—*Lupus* (Lat., wolf), the next neoplasm, is one of the most important diseases in this group. The name was given to the affection because of its great tendency to destroy or eat away tissue, which in severe cases is a marked and terrible feature. The disease, however, is not nearly so frequent in this country as in France and Germany, nor is it so severe. Many cases which formerly would have been called lupus are now recognized as *epithelioma* or rodent ulcer, and many others are found to be forms of syphilis. It must here be mentioned that lupus as properly understood has no connection with syphilis, and that the term syphilitic lupus is wrong. Two forms of lupus are now well recognized and described: *lupus vulgaris* and *lupus erythematosus*. The former appears first in the form of separate rounded tubercles, or collections of soft, red, pulpy tissue in the skin, generally grouped together, forming larger or smaller masses, which may become covered with scales, or may ulcerate and be raw or crusted over. The most common seat of lupus is on the face, though no part of the body is exempt from its ravages; when occurring on the nose, it almost always results in very serious deformity. It is an exceedingly chronic and rebellious disease, not infrequently recurring as often as removed by treatment. The treatment offering the most immediate results is that by surgical interference, in the way of scraping or scarifying the surface; another plan often very serviceable is the destruction of the tubercles by boring them thoroughly with sticks of nitrate of silver. A certain amount can be accomplished by milder means, and the disease can sometimes be removed by ointments and plasters. Internal medication has comparatively little effect upon it, although it may in a measure check its new development. Prominent among the remedies used internally may be mentioned cod-liver oil, which appears to control the lupus process to a slight degree. Arsenic has been lauded by some, but its claims have not been verified by most dermatologists. *Lupus erythematosus* is so named because in many cases the disease is so superficial that it appears almost as an erythema alone, with none of the separate tubercles described as belonging to the first variety. The most common seat of this is also the face, and when completely and characteristically developed we have surfaces of dark red or pinkish skin, of varying size, generally tending to a circular form, and covered with a moderate amount of rather thick, greasy scales, which are quite adherent. These patches do not tend to ulcerate and destroy tissue as do those of lupus vulgaris, but they always leave more or less of a scar. This is one of the most rebellious of diseases of the skin, and very few internal or external remedies have any very certain or powerful influence over it. More recently better results have been obtained by cutting or scraping the surface than from any other means.—*Scrofuloderma* is a term applied to a diseased portion of skin occurring in conjunction with and dependent on that ill defined and yet common state of the system called scrofula. (See SCROFULA.) The skin is dark red, more or less raised in tubercles or masses, which may ulcerate and become covered with crusts; or the tissue may break down and give exit to an unhealthy pus, and a reddened puckered scar result.—*Rhinoscleroma* designates an exceedingly rare disease affecting the nose, wherein a greatly hardened tissue takes the place of the normal structure, which by its continued growth may greatly disfigure the nose, and occlude the nostrils. It is readily destroyed with caustics,

but has considerable tendency to recur.—Leprosy, *elephantiasis Græcorum*, now called lepra, belongs in this group of new formations; it is quite distinguished from the lepra of older writers, now called psoriasis, with which it has no connection. (See ELEPHANTIASIS, LEPRA, and LEPROSY.)—The next new growth is *carcinoma* or cancer. (See CANCER, and TUMOR.) With internal cancer we have little to do at the present writing; but there is a form of skin disease named *epithelioma* which must be noticed, inasmuch as it is regarded by many as the least expressed form of the cancerous state, though there is some doubt as to whether it should really be considered as having any connection with true cancer. Epithelioma often begins in a most insignificant manner. A little, hard, wart-like mass may remain for years without giving trouble; when later it gets scratched, a crust forms, which is picked off again and again, until the ulcer beneath widens and deepens, and acquires hard and everted edges; the sore progresses rapidly, and may cover a great surface, causing much pain and even destroying life. The most common location for epithelioma is about the face, although no portion of the body is exempt from it. The lower lip, especially in males who smoke, is a very common seat; also about the region of the eyes and temples. The name "rodent ulcer" is given to certain forms of this affection, especially about the upper part of the face, which have a tendency to produce deep destruction, and to have hard, everted edges, composed of many separate nodules. Epithelioma, if at all well developed, is always a serious affair, and should receive competent medical attention. In its early stages it is entirely curable by caustics or surgical operation, or both, when pushed far enough to completely destroy the new growth and to reach healthy tissue; but imperfect destruction will be followed by a return of the disease. When the new growth has invaded large surfaces, operative interference seems almost useless, for it is very difficult to secure healing of the wound left without a reproduction of the diseased tissue. Internal medication, as also salves, &c., are impotent to cure the disease.—*Sarcoma* (see TUMORS), as applied to the skin, refers to the development in this tissue, or in the subcutaneous tissue, of one or many tumors of varying size, generally small, from the size of a large pea to that of a hickory nut, but which may become much larger. At first these tumors are freely movable, but soon the skin over them becomes adherent, and if irritated they may ulcerate. Sometimes they have a pigment element, and as they approach the surface the skin becomes bluish black. Unless irritated, sarcoma does not of itself give rise to much if any pain, but may and frequently does do harm, and even destroy life, by the very great development of this peculiar cellular deposit or formation, not only in the skin, but also in internal organs essential to life.

**SKOBELEFF, Mikhail Dimitriyevitch**, a Russian general, born near Moscow in 1845. He graduated at the military academy of St. Petersburg in 1864, and went to Turkistan, where he commanded a company of Cossacks. In 1871 he commanded a battalion of the line in the Caucasus, and was attached to the staff of the grand duke Michael. In 1873 he commanded the advance guard of Lomakin's column in the march upon Khiva, and displayed his independence by disobeying orders. He and the American correspondent McGahan risked their lives by remaining alone in the palace of the khan of Khiva to furnish a report to Gen. Kaufmann. Skobeleff afterward made a reconnoissance in disguise to the Turkoman desert, and for these displays of bravery received a decoration. In the campaign in Khokan (1875), where he served under his father and Gen. Trotzki, he was again one of the most enterprising officers, distinguishing himself at Makhram, at Andijan, and elsewhere, and was rewarded with the rank of general. When, in February, 1876, Khokan was annexed to Russia, he was made its governor. In 1877, in the war against Turkey, having joined the army of the grand duke Nicholas, Gen. Skobeleff served as a volunteer at the crossing of the Danube, swimming the river on horseback, and leading a bayonet charge. He next received command of a flying detachment, with which he took a gallant part in the attack on Plevna, July 30, entering the town and afterward covering the Russian retreat. The capture of Lovatz, Sept. 3, was due in great part to his bravery. In the attack on Plevna of Sept. 11 he was Imeritinski's chief of staff, and led four regiments, with which he captured and held for twenty-four hours two redoubts, being ultimately forced to retire with terrible loss. He was made a lieutenant general and chief of the 16th division. He was one of the principal leaders in the combined attack on the Shipka army, which resulted in its capture, Jan. 9, 1878. He commanded the advance on Adrianople, which he captured unopposed, and led the advance on Constantinople, occupying Tchatalja on Feb. 6. After the conclusion of peace he had charge of the retiring army; and in the summer of 1880 he was appointed to the command of a new expedition against the Tekke Turkomans.

**SMART, John**, a British painter, born in Edinburgh about 1840. He received his education and has spent the greater part of his professional life in his native city. He has depicted chiefly the wild, barren scenery of the highlands, occasionally introducing cattle. He was elected a member of the Scottish royal academy in 1877. His works include "The Frist of Winter's Snaws," "Autumn, Glen Lyon," "Drumharry," "Head of Glen Ogle," "Hill Frank — Clipping Day," "A Feeding Storm," "In the Pass of Lyon," "Far from the Busy World," "When Hill-taps a' were White," and "Halt of the Herd." His "Gloom

of Glen Ogle" was at the Philadelphia exhibition of 1876.

**SMILLIE. I. James**, an American engraver, born in Edinburgh in 1807. After working some time as an apprentice to silver and picture engravers, he was brought to America at the age of 14, and worked for his father and brothers, who established themselves as jewellers in Quebec. His skill attracted attention, and he was sent back to Edinburgh, where he remained five months under Andrew Wilson, and then returned to Quebec. In 1829 he settled in New York, where he has been largely connected with bank-note engraving. Among his best plates are: "The Convent Gate," after R. W. Weir; "Voyage of Life," after Cole; "Rocky Mountains," after Bierstadt; "The Bay and Harbor of New York," after John J. Chapman; "Dover Plains," after A. B. Durand; "Evening in the New York Highlands," after Weir; "Mount Washington, from Conway Valley," after John F. Kensett; "American Harvesting," after J. F. Cropsey; and "The Land of the Cypress," after Huntington. **II. James D.**, an American painter, son of the preceding, born in New York in 1833. He devoted himself to engraving until 1864, when he turned his attention to drawing and painting, studying among the great mountain ranges of the United States. In 1862 he made a short visit to Europe. He was president of the American society of painters in water-colors from 1873 to 1878, and has contributed regularly to its exhibitions and to those of the national academy of design, of which he is an official member. His works include "Evening among the Sierras of California," "The Lifting of the Clouds, White Mountains," "Dark against Day's Golden Death," and "Cedar Meadow, Poughkeepsie," all in oil; in water-colors, "A Scrub Race on the Western Prairies," and "The Track of the Torrent, Adirondacks." "The Scrub Race" and "A Study from Nature, Ausable River," were at the centennial exhibition in 1876. For "Picturesque America" he illustrated the Saguenay and the Yosemite, and also furnished the description of the latter. **III. George H.**, an American painter, brother of the preceding, born in New York in 1840. At an early age he entered the studio of James M. Hart. In 1871 he made a trip to the Rocky mountains and the Yosemite valley, for the purpose of study and sketching; and in 1874 he visited Florida. His works include "Boquet River and Hills," "Under the Pines of the Yosemite" (water-color), "A Lake in the Woods," "A Florida Lagoon," "Hard Fare," "Late Autumn," and "A Goat Pasture." He sent his oil painting "Lake in the Woods" to the centennial exhibition at Philadelphia in 1876; also his two water-colors, "Sentinel Rock, Yosemite Valley," and "Study on the Ausable River, New York."

**SMITH, Francis Hopkinson**, an American painter, born in Baltimore in 1838. He has made New York his home, and exhibited most of his works at the water-color exhibitions there. He was elected a member of the water-color society in 1871, and treasurer in 1873, which post he still holds (1880). His works include "Summer in the Woods, White Mountains," "The Old Man of the Mountain," "Overlook Falls" and "Walker's Falls, Franconia Notch," "A Summer's Day," "Grandfather's Home," "In the Darkling Woods," "Under the Leaves," "Deserted," "The Old Smithy," and "Looking Seaward." He sent his "Old Cedars, Franconia Mountains," and "In the Darkling Woods," to the Philadelphia exhibition of 1876. He is also an engineer and a contractor to build lighthouses.

**SONNTAG, William Louis**, an American painter, born in Pennsylvania in 1822. He has followed his art in Cincinnati, in Italy, and in New York, where he has lived since 1860. His works include "The Progress of Civilization" (comprising four paintings), "Alastor, or the Spirit of Solitude" (from Shelley), "The Eagle's Home," "The Dream of Italy," "The Spirit of the Alleghanies," "A View of the Shenandoah," "Recollections of Italy," "Sunset near Bethlehem, N. H.," "Sunset in the Swamp, near the Coast of Maine," "The East River in February," "A View in Vermont," "The Gulf," "Deserted," "A Passing Shower," "Clement's Brook, N. H.," "Hour after Sunset" and "Hour before Sunrise" (on the Susquehanna), "Among the Tangled Woods of New Hampshire," and "A View near Harper's Ferry, Va." His "Sunset in the Wilderness" was at the centennial exhibition in Philadelphia in 1876.

**STARS.**—*Double and Binary Stars.* The principal recent discoveries of double stars have been by Mr. E. W. Burnham of Chicago, who has in press (1880) an extensive catalogue of double stars, and is actively engaged in measures. Minor lists of new doubles have been published by Prof. Stone of Cincinnati and others. M. Flammarion of Paris, and Messrs. Gledhill, Crossley, and Wilson of England, have recently published valuable compendiums on the subject of double and binary stars in general. M. Dunér of Lund has published the results of nine years of observation on the double stars discovered by the elder Struve. The work extends over the years 1867-'75, and embraces 2,679 observations. A pretty full discussion of the earlier observations is given, and from his results it follows that there are 8 of Struve's stars which since the original discovery have made a complete revolution; 8 which have moved through half a revolution, or 180°; 8 which have moved through 90°; 16 which have moved through 30°; 48 which have moved through 10°; and 59 which are certainly in motion. That is, 147 stars of this list are certainly binary. Vol. i. of the publications of the Dun-Echt observatory (Lord Lindsay) supplies the place of a general catalogue of the double stars of W. Struve. It is a collection of all the doubles discovered by Struve (3,000

or more), arranged in one order, with details regarding each star. The most noted multiple star is the system of four bright stars and two fainter ones, critically situated in the centre of the great nebula of Orion. In 1877 Signor Nobile of Naples gave a discussion of his measures of this system, and a comparison with earlier observations by W. Struve and Liaponoff. Prof. Hall of Washington has made an elaborate two-years' series of measures on the same system, which has been discussed by Prof. Holden, who comes to the same result as that of Nobile and of W. Struve, viz., that the stars of this system are physically connected and in a slow relative motion. O. Struve, in his last observations, gives a discussion of his own long series of measures, and comes to the same conclusion as to physical connection, but not as to relative motion. It may fairly be said to be established that this group constitutes a sidereal system. The following are the elements of the more important binary stars. Eight have moved through an entire revolution since the first observation, and about 150 have moved through an arc of over 10° since they were first observed. In the tables the semi-major axis, or mean distance, must be given in seconds, since we have usually no data for fixing its value in linear measures of any kind. Periods of revolution exceeding 120 years are uncertain.

| NAME OF STAR. | Period (years). | Time of periastron. | Semi-axis major. | Eccentricity. | Calculator. |
|---|---|---|---|---|---|
| 42 Comæ Berenices | 25·7 | 1869·9 | 0·65″ | 0·48 | Dubiago. |
| ζ Herculis | 34·6 | 1864·9 | 1·36 | 0·41 | Flammarion. |
| 3121 Σ * | 37·03 | 1842·8 | [0·71] | 0·26 | Doberck. |
| η Coronæ Borealis | 40·2 | 1849·9 | 0·99 | 0·29 | Flammarion. |
| ξ Libræ | 95·90 | 1859·6 | 1·26 | 0·08 | Doberck. |
| γ Coronæ Australis | 55·5 | 1882·7 | 2·40 | 0·69 | Schiaparelli. |
| ξ Ursæ Majoris | 60·6 | 1875·6 | 2·58 | 0·38 | Hind. |
| | 60·6 | 1875·5 | 2·54 | 0·37 | Flammarion. |
| ζ Cancri | 62·4 | 1869·3 | 0·90 | 0·00 | O. Struve. |
| | 60·5 | 1869·9 | 0·91 | 0·37 | Flammarion. |
| α Centauri | 85·0 | 1874·9 | 21·80 | 0·67 | Hind. |
| 70 Ophiuchi | 92·8 | 1807·9 | 4·88 | 0·39 | Flammarion. |
| γ Coronæ Borealis | 95·5 | 1843·7 | 0·70 | 0·35 | Doberck. |
| 3062 Σ | 104·4 | 1834·9 | 1·27 | 0·46 | Doberck. |
| ω Leonis | 114·6 | 1841·6 | 0·85 | 0·55 | Doberck. |
| λ Ophiuchi | 233·9 | 1803·9 | 1·19 | 0·49 | Doberck. |
| ρ Eridani | 117·5 | 1817·5 | 3·82 | 0·38 | Doberck. |
| 1768 Σ | 124·5 | 1863·0 | .... | 0·66 | Doberck. |
| ξ Boötis | 127·4 | 1770.7 | 4·86 | 0·71 | Doberck. |
| γ Virginis | 175·0 | 1836·5 | 3·39 | 0·87 | Flammarion. |
| τ Ophiuchi | 217·9 | 1821·9 | 1·40 | 0·61 | Doberck. |
| η Cassiopeæ | 222·4 | 1909·2 | 9·83 | 0·57 | Doberck. |
| 44 Boötis | 261·1 | 1783·0 | 3·09 | 0·71 | Doberck. |
| 1938 Σ, μ² Boötis | 280·3 | 1863·5 | 1·47 | 0·60 | Doberck. |
| 36 Andromedæ | 349·1 | 1798·8 | 1·54 | 0·65 | Doberck. |
| γ Leonis | 402·6 | 1741·1 | 2·00 | 0·74 | Doberck. |
| δ Cygni | 415·1 | 1904·1 | 2·31 | 0·28 | Behrmann. |
| 61 Cygni | 452·0 | ...... | 15·40 | .... | |
| σ Coronæ Borealis | 845·9 | 1826·9 | 5·89 | 0·75 | Doberck. |
| α Geminorum | 1001·2 | 1749·8 | 7·43 | 0·33 | Doberck. |
| ζ Aquarii | 1578·3 | 1924·2 | 7·64 | 0·65 | Doberck. |

—*Clusters.* Within a few years several important monographs of clusters of stars have been published. These usually give the relative positions of the stars of the cluster, and the absolute position of some one or more of the brighter stars, together with the magnitudes of the component stars. In future years these data can be again determined, and the question of change settled. To do this, extremely accurate determinations are now required. Special researches of this kind have been lately made by Wolf of Paris, Vogel of Potsdam, Koch of Hamburg, Valentiner of Mannheim, and others, by the usual micrometric measures. Our countrymen, Dr. Rutherfurd of New York and Dr. Gould of Cordoba, Argentine Republic, have applied photography to the settlement of this question, and each of these gentlemen has secured a large number of negatives of clusters and smaller groups of stars. The positions of about 50 stars in the Pleiades were determined with great precision by Bessel, with the Königsberg heliometer. M. Wolf of Paris has made a further study of this important group by means of the ordinary filar micrometer, and has fixed the places and magnitudes of about 500 stars. His conclusions are, that the stars of this group are in fact physically connected, since he has found evidence of a proper motion common to all; and that many of the component stars are variable in brightness. No marked relative motion of stars within the group has been detected. The Savilian observatory is repeating Bessel's work with a new form of micrometer.—*Proper Motion.* Mr. E. J. Stone, Radcliffe observer, has pointed out facts which seem to indicate a past connection between four southern stars. These stars are:

| NAME OF STAR. | Magnitude. | R. A. | N. P. D. | Proper motion. |
|---|---|---|---|---|
| ζ Toucani | 4·0 | $3^h\ 14^m$ | 155° 35′ | — 1·13″ |
| e Eridani | 4·5 | $3^h\ 15^m$ | 133° 32′ | — 0·75″ |
| ζ¹ Reticuli | 5·6 | $3^h\ 15^m$ | 153° 2′ | — 0·65″ |
| ζ² Reticuli | 5·6 | $3^h\ 16^m$ | 152° 58′ | — 0·65″ |

* 3121 Σ signifies No 3121 of W. Struve's Dorpat catalogue.

Observations of these stars are available for 130 years. From a discussion of these, the conclusions of Mr. Stone are: 1. "The four stars of the group have proper motions much larger than the average." 2. "They have a common proper motion of more than a second of arc." 3. "Each star of the group is moving away from every other star of the group, by quantities which are small compared with the common proper motion of the group." 4. "That, roughly speaking, the velocities of separation are larger, the larger the present angular separation of the stars." It appears to Mr. Stone very probable that these stars at a remote period (more than 300,000 years, for example) really formed a system or group. Such a group might have been formed by the close approach of two binary stars. Though the conclusions are necessarily doubtful, the case is interesting.—*New Stars.* In November, 1876, Dr. Schmidt, director of the Athens observatory, discovered a new star of the third magnitude in the constellation Cygnus. Its brilliancy diminished rapidly at first to below visibility to the naked eye. In 1877 it had further diminished to 10½ magnitude. The most interesting results have been derived from spectroscopic observations of this star. Its spectrum was at first twofold. On a continuous spectrum, analogous to that of the sun, and no doubt due to the light of the solid or liquid photosphere, there was superposed a second spectrum of bright lines, which was due to light coming from incandescent gases, notably hydrogen. The hydrogen lines were at first very brilliant; with the decrease in their brilliancy a line corresponding in position to the brightest of the lines of a nebula strengthened. In December, 1876, this last line was much fainter than the F hydrogen line of the solar spectrum, while in March, 1877, F was much the fainter of the two. The spectrum of the star degraded from its first complex character, so that in the latter part of 1877 it emitted only monochromatic light, corresponding in position to the strongest line in the ordinary nebular spectrum. If the object had then been first observed, any spectroscopist would have pronounced it unhesitatingly to be a gaseous nebula; and it is clear that we have actually witnessed a reversal of the process imagined by Sir William Herschel: that is, a star has actually become a planetary nebula.—*Photographs of Star Spectra.* Most interesting photographs of the spectra of stars and planets have been made by Dr. Huggins of London and Dr. Draper of New York.—*Star Catalogues.* The *Durchmusterung des nördlichen Gestirnten Himmels*, the joint work of Argelander and his assistants, Krüger and Schönfeld, embraces all the stars of the first nine magnitudes from the north pole to 2° of south declination. This work was begun in 1852, and at its completion a catalogue of the approximate places of 324,198 stars, with a series of excellent star maps giving the aspect of the northern heavens for 1855, was at the service of astronomers, and has been in the most constant use from that time forward. Argelander's original plan was to carry this *Durchmusterung* as far as 23° south, so that every star visible in a small comet-seeker should be registered. This plan was abandoned, but Dr. Schönfeld, at the observatory of Bonn, is now (1880) engaged in executing this work. The equinox of 1855 is chosen as the fundamental one; and almost the only changes are the adoption of a telescope of six inches aperture for the work, and a closer discrimination of the magnitudes of the fainter order of stars. Schönfeld has already made 243,000 observations, and astronomers in the northern hemisphere will soon possess an index, as it were, to every star likely to be used in their observations. Prof. O. Stone of the Cincinnati observatory is extending this review still further south. Both his results and those of Schönfeld are as yet unpublished. The astronomical society of Germany, founded in 1865, has instituted a plan for the reobservation of the 324,000 stars from the first to the ninth magnitude (inclusive) found in the *Durchmusterung.* The observations of Argelander and his assistants were made with a small comet-seeker, and give only approximate positions. The plan of the society contemplates the reobservation of each of these stars by means of large meridian circles, so that accurate places may be available. These stars serve as points of comparison to which are referred the positions of comets, asteroids, &c. By dividing the space to be covered (from the north pole to 92° N. P. D.) into zones, the coöperation of many observatories is secured, and a prompt publication of the resulting catalogues is made possible. In 1878 the various zones were assigned as follows to the observatories engaging in the work: Nikolayev, $-2°$ to $+1°$; Albany, 1° to 5°; Leipsic, 5° to 15°; Cambridge, England, 25° to 30°; Leyden, 30° to 35°; Lund, 35° to 40°; Bonn, 40° to 50°; Cambridge, United States, 50° to 55°; Helsingfors, 55° to 65°; Christiania, 65° to 70°; Dorpat, 70° to 75°. A catalogue of red stars, with observations of them, has been published by Mr. Birmingham of Ireland: 658 red or reddish yellow stars are given, none fainter than the tenth magnitude. Secchi has also published a list of 444 red stars. The importance of such lists depends upon the fact that it is found that most red stars are variable, and Birmingham gives it as a result of his observations that for variable red stars the red color in general increases as the star gets fainter, and *vice versa.*—*Uranometry.* In 1872 Dr. Heis of Münster published in the *Neuer Himmelsatlas* the results of 27 years' labor on the stars visible to the naked eye. It is on the same plan, and the scale is the same, as the *Uranometria Nova* of Argelander. But Heis has extended the scale of magnitudes beyond 6·0 mag. (where Argelander stopped) to about 6½ mag.,

as his eyes are more than commonly acute. It may be said, in passing, that under good circumstances he always sees $\alpha^1$ and $\alpha^2$ Capricorni divided, and usually $\omega$ Scorpii, $\delta$ Lyræ, and $\epsilon$ Lyræ; while in the Pleiades, besides the six stars which every eye can see, he can distinguish four more. Thus, more stars are to be found in Heis than in Argelander. The former has 3,507 stars from the first to the sixth magnitude, while the latter has 3,256. Heis has in all 5,471 stars visible to the naked eye under the best circumstances at Cologne, Germany; that is, from the north pole to about 130° of north polar distance. One important feature of his work is the accurate delineation of the milky way, both in position and brightness. A similar work was published in 1874 by Dr. Behrmann, who made a voyage during 1866 in the southern hemisphere, and devoted ten months to making a uranometry on Argelander's plan (and with his scale of magnitudes) of the sky from the south pole to 70° south polar distance. He gives 2,344 stars in this space. M. Houzeau, director of the Brussels observatory, has presented to the Belgian academy of sciences a uranometry of all the stars visible to the naked eye in the West Indies, more than 6,000 in number. The work has not yet appeared in print. The most important contribution of this kind which has appeared since 1843 (the date of the publication of the *Uranometria Nova* of Argelander) is the *Uranometria Argentina* of Dr. B. A. Gould (1879). It is the result of nearly ten years' work at the national observatory of the Argentine Republic, and covers the whole southern heavens and 10° of the northern. The magnitudes are on Argelander's scale, but this had to be extended to 7·0 mag., since the naked eye at Cordoba can distinguish stars a full magnitude fainter than at Bonn; that is, stars having only $\frac{4}{10}$ of the light of the *minimum visibile* of Argelander. The space examined covers about $\frac{4}{7}\frac{1}{0}$ of the whole sky. Within it 10,649 stars were visible under the best circumstances, and more than 46,000 observations were made, or over $4\frac{1}{2}$ for each star. Many variable stars were discovered, some of which received special attention. Sequences were observed in the manner of the Herschels, and Dr. Gould declares his firm conviction that of all the stars down to the 7·0 mag. inclusive, at least half are variable. This conclusion differs from that of C. S. Peirce on the general variability of the stars. Procyon and Altair are included among those slightly variable. Of stars of the 7·0 mag. and brighter, 8,198 are recorded in the *Uranometria Argentina;* 2,451 fainter have been observed, but are excluded. The *Uranometria Nova* contains 3,256 stars visible in the whole sky, or 2,384 in the northern hemisphere. Dr. Gould's results give 6,694 southern stars. This shows strikingly what has long been known in a general way, that the southern heavens are far richer in the stars visible to the naked eye, though not specially so in the brightest classes of these stars. Dr. Gould has completely revised the boundaries of the constellations of the southern sky. He throws away the fantastic boundaries derived from the supposed resemblances of the configurations of the stars to the forms of animals, &c., and substitutes geometrical boundaries which are easily memorized, and are always definite and certain. Although the changes are most marked, the revision has been done so carefully that but seven stars of the *Uranometria Nova* receive different names in the *Uranometria Argentina*, and of these seven no one is as bright as the fifth magnitude. Dr. Gould's conclusions as to the situation and shape of the cluster of stars to which our solar system belongs are: "There is in the sky, a girdle of bright stars [from first to fourth magnitude], the medial line of which is nearly a great circle inclined to the milky way by about 20°. The grouping of the fixed stars brighter than 4·1 mag. is more symmetric relative to that medial line than to the galactic circle. These facts, together with others, indicate the existence of a small cluster within which our system is eccentrically situated, but which is itself not far from the middle plane of the galaxy. This cluster appears to be of a flattened shape, somewhat bifid, and to consist of somewhat more than 400 stars of magnitudes from 1 to 7, their average magnitude being about 3·6." The milky way has been also most carefully studied, and measures of great value are given in regard to its dimensions. Dr. Gould says: "There are indications that the whole phenomena of the milky way may become simplified by treating it as the resultant of two or more superposed galaxies." The conclusions on the cluster of the brighter stars agree strikingly with those of Mr. Peirce in his "Photometric Researches," and Dr. Gould's conclusions as to the milky way confirm Mr. R. A. Proctor's views.

**STEAM HEATING**, the warming of the air of inhabited rooms with the heat which is set free on the condensation of steam. The heat stored up in steam, which is released when the steam, without falling in temperature, is condensed to water, is sufficient to raise the temperature of 10 units of water for each unit of weight of steam condensed 50° C., or to raise 10 units of air for each steam unit 210°. The first recorded application of steam to the warming of buildings was made by James Watt in 1784. He constructed an apparatus for warming his study, consisting of a narrow box $3\frac{1}{2}$ ft. long with sides of tinned iron placed about an inch apart. The steam was conducted into this heater, which stood on edge, from a boiler, warming the room with the heat liberated on condensation, the condensed water flowing back into the boiler by the same pipe through which the steam ascended into the box. A similar plan was patented in England in 1791 by Hoyle, but failed through a defec-

tive design. In 1799 Lee devised a heating apparatus in which cast-iron tubes served the double purpose of conveying the steam and supporting the floor. Steam is used both at high and at low pressure in the different appliances invented for warming houses. One advantage which steam heating possesses over heating by hot-water pipes is, that the steam pipes can be made to run in any direction. The only precaution necessary is to provide an outlet for the water of condensation to pass off at every change of level. The condensed water can be used over again in the boiler, and may also be applied to the sanitary uses of distilled water. In the first large building heated by steam, a silk mill in England, the pipes were arranged in the manner which it is desirable to approximate as nearly as possible in all cases, with a gentle and continuous inclination down to the boiler. Though steam heating was regarded with favor and frequently practised in the early part of the century, it fell into neglect after the introduction of the methods of warming with hot-water pipes.—The chief difficulty with steam heating is the attention the apparatus requires in order to insure an even supply of steam. When the steam fails, the heaters immediately grow cold. Explosions seldom occur; but there is always more or less danger with careless or inexperienced attendants. Formerly it was considered unsafe to use steam at a higher pressure than 2½ lbs. to the square inch in the boiler; but the use of high-pressure steam with engines has become so common that 10 or even 20 lbs. pressure in a steam-heating apparatus is not now considered dangerous, though where a special boiler is used a greater pressure than 5 or 10 lbs. is not desirable. With higher pressure in the boiler and pipes, a smaller radiating surface is required. When low pressure was used, it was considered necessary to have a steam space in the boiler equal to the whole cubic contents of the pipes, so that the pipes would readily fill with steam when the valves were opened. With high-pressure steam, smaller boilers are used; yet it is always economical to have as large a boiler surface exposed to the fire as is possible. The boiler and pipes should be so proportioned that the former will evaporate the same quantity of water in a given time as the latter condense. Experiments and calculations show that with a boiler surface of 4 sq. ft. exposed to the direct action of the fire, the surface required to evaporate 1 cub. ft. of water per hour, 182 sq. ft. of pipe will be necessary, the temperature of the room being 60° F., when the pressure is 2½ lbs. above the atmosphere; 161 sq. ft. at 10 lbs., 149 sq. ft. at 20 lbs., and 135 sq. ft. at 80 lbs. In common practice, however, a considerably larger boiler surface, perhaps 6 sq. ft., must be allowed to produce the same result. The boiler should be simple in form and easy to clean, larger in proportion to the fire surface than ordinary, and very durable. The cylindrical boiler with hemispherical ends is one of the strongest forms, and is well adapted for high pressure. Besides the usual fittings of steam boilers, a steam-heating apparatus should be provided with an automatic appliance for injecting water into the boiler. The injector longest in use is the stone-float apparatus, in which a stone is connected with a lever within the boiler, which opens a cock communicating with an elevated cistern. When the water evaporates below a certain quantity, the float falls, opening the cock, and letting in sufficient water to float the stone and close the cock again. With low-pressure apparatus an inverted siphon pipe may be used for the escape of the condensed water. Where steam of high pressure is employed, a number of different contrivances have been devised which allow the water to flow off while preventing the escape of steam. A cock is generally placed at the connection of the pipe with the boiler. When this is opened the steam drives the air in the pipes before it; but unless a means of exit is provided for the imprisoned air whenever the steam is turned on, the pipes in which the air remains will continue cold. When the pipes are laid horizontally, a blowpipe at the further ends allows of the expulsion of the air without difficulty. When the pipes occupy different levels, more complicated contrivances are required; and sometimes it is necessary to employ an air pump. The method of heating buildings by steam can be employed with the greatest economy in premises where steam is used for driving an engine. The boiler should be enlarged to supply steam for warming in the proportion of 1 cub. ft. for every 2,000 cub. ft. of space to be heated; a boiler adapted to an engine of one-horse power can be made large enough to furnish steam for warming a space of 50,000 cub. ft.—The warming of the British houses of parliament is accomplished according to Gurney's modification of the system of Dr. Reid, first tested in the temporary house of commons erected in 1835. Fresh air from without is filtered through screens, and warmed by passing over iron boxes filled with steam, entering the halls through perforated floors, over which porous horsehair cloths are spread to prevent the currents from being felt. In summer the air is cooled by a spray of cold water in the same lower chambers before ascending into the halls. In a series of experiments carried on during the centennial exhibition at Philadelphia in 1876, a very effective method of heating air was shown, which consisted in forcing currents of air over a steam pipe by means of a fan. From the results of trials with an exhaust fan it appeared that—while by an ordinary steam coil heat is transferred to the air only at the rate of ·0003 of a unit of heat per hour for each degree of difference between the temperature of the steam inside the tubes and the air outside—when the air is forced across the tubes at the

rate of $39\frac{1}{2}$ ft. a second, the heat is imparted to the air at the rate of 87·5 heat units for each degree of difference between that of the temperature in the heater and the external air. This method of heating air is therefore nearly 3,000 times as rapid and efficient. The steam required to drive the fan can be used to furnish the heat. The heater and fan should be so designed that all the steam which is required to furnish the necessary power may be thus utilized. Walker's heater has been much used both for steam and hot water. It consists of a number of small iron blocks, each having square perforations passing through it for the passage of air upward and downward; the blocks being enclosed in an iron box with corresponding perforations, with an inch of space for the steam around each block, which heats the thin metal of which they are composed, while they heat the circulating air. By this arrangement 160 ft. of heating surface can be obtained in a box measuring only 2 cub. ft. The plan of heating hothouses by discharging steam directly into the place containing the plants, the moisture causing them to thrive more luxuriantly, was adopted about the time of the first inventions for house-warming by steam. A simple steam-generating apparatus is made by placing in a furnace a series of concentric heating coils, at the lower end of which the water enters from a reservoir, into which the condensed water returns from the steam pipes. By another arrangement, the pipes in which the steam is generated form the basket grate of the furnace. A sectional boiler is sometimes made by connecting with vertical pipes a series of inclined pipes, communicating at their upper end with the heaters, and receiving the water of condensation at their lower end. A furnace is made in which the steam-generating pipes line the furnace, form the sides of the basket grate below, the bottom of which is given a longitudinal agitation by a ribbed rocking bar, and, winding in a convolved series, fill the space in the furnace above the fire; these horizontal pipes are connected by vertical pipes and headers; the condensed water enters the lower end of the generator from a receiver in front of the furnace.—The Holly system of steam heating is a method of heating city buildings from a central source by means of steam conveyed in main pipes through the streets, and conducted to radiators in the houses. This system was first put in practice in Lockport, N. Y., in a form elaborated by Birdsell Holly, a citizen of that place. Other inventors had proposed similar schemes for economical heating. Coleman's, which was never carried into execution, was essentially the same as Holly's. The Holly works in Lockport were put in operation in the autumn of 1877. After settling, by experiments extending over ten years, upon the materials for the conduit pipes, the form of generator, the meters, and all the details of the apparatus, a company was formed with a capital of $25,000, which proposed to heat the dwellings and public halls of the town at a price somewhat below the cost of warming by hot-air furnaces. The second winter 1,000 consumers were supplied, and an aggregate space of about 10,000,000 cub. ft. was heated. The average cost for each consumer was found to be $57.80, counting $18 for interest on the cost of fixtures and that of maintaining them in good order; against $113.75 required to keep a furnace using 10 tons of coal per annum, and $197 required annually to maintain a private steam-heating apparatus consuming 12 tons of coal. The street mains are wrought-iron pipes covered with an inner packing of asbestus, which is enclosed in a jacket of cow-hair felting or some similar non-conducting substance, upon which hard-wood strips are firmly bound with copper wire. The pipes, thus packed and protected, are inserted into holes bored through logs of wood, the holes being large enough to leave an air chamber around them. The logs are laid at an incline over tile drains. A comparison of different sizes of pipes with regard to their capacity for conveying steam shows that the distance to which steam can be carried increases threefold when the diameter of the pipe is doubled: a $1\frac{1}{2}$-inch pipe will deliver steam about 1,000 ft. from the boiler; a 3-inch pipe, 3,000 ft.; a 6-inch pipe, 9,000 ft. Steam is served by the Lockport works as far as a mile and a third away from the boiler house. The steam is received from the boiler in a 6-inch main, which branches into two 4-inch, and these again into two 3-inch mains each. The 3-inch pipes divide into the smallest size of street mains used, $1\frac{1}{2}$ inch in diameter. The total length of pipe laid was about five miles. The consumption of coal in the Lockport works the first winter, when only one or two of the six boilers were used at a time, was from $2\frac{1}{2}$ to 3 tons a day. With larger boilers and pipes, steam might be conveyed and distributed over an area of four square miles from a single boiler house; although it might be more economical to make the districts to be heated from one station smaller. The isolation of the pipes is remarkably perfect, and the heat which escapes serves a very useful purpose in preventing the hydrants in the streets from freezing up. It is estimated that 10 boilers 16 ft. long and 5 ft. in diameter, with 54 tubes each, will warm an aggregate space of 15,000,000 cub. ft., furnishing steam for heating 1,300 cub. ft. to each square foot of heating surface in the boilers. The loss by condensation in 1,600 ft. of 3-inch pipe, the head of steam being kept at a pressure of 18 lbs., corresponds to the consumption of 9 lbs. of coal an hour; with that length and size of pipe in an ordinary city street, 100 houses can be supplied, making the loss by condensation for each consumer equivalent to 2·16 lbs. of coal a day. With a pressure in the pipes of 60 lbs., or four atmospheres, it required, when the sup-

ply of steam was cut off, 18 minutes for the pressure to fall to 45 lbs., 28 minutes more for it to sink to 30 lbs., 40 minutes longer for it to decline to 15 lbs., and 54 minutes longer, or 2 hours and 20 minutes altogether, for it to become reduced to the pressure of the atmosphere, or for the four atmospheres of steam to become entirely condensed. In addition to the remarkably efficient service of the coverings and packing used to isolate the pipes, a further economy is effected by a process for reconverting into steam a portion of the water of condensation. Important features in the Holly system are the regulating and measuring apparatus placed in each house, and the distributing and junction chambers which are placed at intervals of 100 ft. or more along the street mains. These junction boxes provide for the longitudinal contraction and expansion of the pipes, affording at the same time a space for the apparatus by which the steam is distributed. The service pipe where it enters the junction box has attached to it a hood into which the water of condensation collects. This is conveyed to a valve in the house, where it is wire-drawn, and in consequence of the reduction of pressure, which is about 50 lbs. to the square inch, a large portion of it is reconverted into steam, which is fed into the radiators. A valve, similar to the slide valve in a high-pressure engine, admits the steam from the street main into a short pipe, which has a similar valve at its other end connecting with the radiators. These valves serve both as regulators and meters. The pressure on both sides of the valves is shown by steam gauges. An indicator registers the consumption of steam in figures which show its value in dollars and cents. The Holly system, after two years of successful operation in Lockport, was introduced in Springfield, Mass., Auburn, N. Y., and other towns. The actual economy over ordinary modes of heating can be arrived at only after it has been at work long enough to test the durability and security of the conducting pipes. The greatest advantage of this method of artificial heating, the reduction in the risk of fire, will be the slowest to obtain practical recognition, owing to the custom of transferring most of the risk to insurance companies, which derive a profit from their guarantee.

**STEEL, Dephosphorization of.** Although the phosphorus is sufficiently eliminated from iron in the puddling process, it is not removed in either the Bessemer or the open-hearth system of manufacturing soft steel. The extreme heat required in the Siemens furnace and Bessemer's converter has been supposed to be the reason why the phosphorus cannot be got rid of. This heat, exceeding that of any other industrial process, necessitated the use of silica as a coating to the furnace or converter, the only substance supposed to be able to resist it. As a consequence, only a limited number of iron ores, containing a minimum of phosphorus, could be used in the manufacture of Bessemer steel; of the different ores of Great Britain, not more than one eighth were adapted for this purpose. Parry patented a process in 1861 for obtaining pig iron freed from phosphorus and sulphur. Several other methods of purifying iron and steel have since been devised by Bell, Krupp and Bender, Jacobi, Velge, Tessié du Motay, and others; but until the introduction of the Thomas-Gilchrist process the production of Bessemer steel was only possible from a very limited number of ores. The substitution for silica of a basic substance, like lime, in the lining of the furnace, was the means by which these inventors sought to work out the problem of dephosphorization. Snelus and other metallurgists had long before suggested the use of lime, and Siemens had undertaken a series of experiments to that end, but without success. The softness and want of coherence of lime render it a most unmanageable material for furnace linings. Several years were consumed by Gilchrist and Thomas at Blaenavon in experimenting with oxide of iron, alumina, lime, and limestone. They finally succeeded in obtaining, instead of an acid lining like silica, a basic one which was as hard and compact as the best silica bricks. The new bricks, which were strongly basic, were composed of a special kind of magnesian limestone. This was ground, and subjected to intense firing and great shrinkage, passing through chemical changes from which it emerged as hard and firm as silica, and even more infusible. But this was only the beginning of success; for when a pig of phosphoric steel was blown in a furnace lined with these bricks, it was not sufficiently dephosphorized, while the lining itself was so injured that it had to be replaced after four or five blasts. The attempt to assimilate the process of steel-making to that of puddling was abandoned as impracticable. After long experimentation the right process was evolved, by which the phosphorus is made to combine with the base, and is carried off in the slag. The manufacture of steel by the Thomas-Gilchrist process was commenced in the English district of Cleveland in 1879. The perfected process is complex, and its details have been developed experimentally. To the silica resulting from the oxidation of silicon is supplied lime or magnesian lime, apart from that in the lining, with which it unites at the moment of its formation. The lime and magnesia in the slag must not be less than 40 per cent., and the silica must be less than 20 per cent. When the latter is under 16 per cent., the best results are obtained. The slag from Bessemer and Siemens furnaces ordinarily contains above 40 per cent. of silica, and little lime or none at all, while the cinder contains not over 5 per cent. The quantity of the base added in the new process amounts to from 9 to 14 per cent. of the weight of pig converted, varying with the character of the pig. A portion is added before the metal is

introduced, and the remainder after the oxidation of the silicon. Of the total additions, lime constitutes five parts out of six. It is preferable to have the substances added hot, but this is not absolutely necessary. They can be heated economically by utilizing the heat of the gases in the converter. The silicon, upon being oxidized by the blast, enters into combination with the loose lime forming the interior fettling or fixing, but does not act upon the material which composes the true lining of the hearth. The carbon is thus attacked, and the phosphorus, coming in contact with a strong free base in a loose condition, with which it can unite when oxidized, is oxidized by the blast and passes into the slag. The heat evolved in the oxidation of the phosphorus, which is very intense, assists greatly in the success of the operation. The Gilchrist and Thomas system of lining and of adding lime in the fixing can be employed either in Bessemer converters or in the Siemens or other open-hearth furnaces. It has been successfully adapted also to the Ponsard process. The extra cost for adding the bases is found to be only about 1*s.* 6*d.* a ton. The bricks cost no more than silica bricks, and seem to make as durable a lining. Gilchrist and Thomas were assisted in their experiments by Mr. Martin, and afterward were substantially supported by E. Windsor Richards, and the large establishment of Bolckow, Vaughan and co. was placed at their disposal. The new steel process there developed, with improvements added by Snelus and Riley, was soon adopted in all the great iron-producing countries of Europe. The basic bricks were first manufactured by the above firm alone. A large factory was subsequently established at Duisburg in Westphalia.

**STEELL, Sir John,** a Scottish sculptor, born in Aberdeen in 1804. He studied in Edinburgh and Italy, and in 1833, on his return from Rome, opened a studio in Edinburgh, where he has since lived. Early in his career he received the appointment of her majesty's sculptor for Scotland. In 1876 he was knighted upon the unveiling of the Scottish national memorial to the prince consort in Edinburgh. His works include a statue in Carrara marble of Sir Walter Scott, in the well known Scott monument in Edinburgh, of which there is a duplicate in bronze in the Central park, New York; a companion statue of Robert Burns; statues of Wellington, Prof. Wilson, Allan Ramsay, and Thomas Chalmers, all in bronze, in the public streets of Edinburgh, and a statue of the queen in the royal institution there; the monument to the 42d Highland regiment, at the cathedral of Dunkeld; the monument to the 93d Highlanders, in Glasgow cathedral; statues of Lords Melville and Jeffrey; busts of the queen, Prince Albert, the duke of Wellington, the duke of Edinburgh, Florence Nightingale, and many others. At the Lenox library, New York, are busts of Dr. Thomas Chalmers and Sir Walter Scott, both executed by him.

**STEVENS, Alfred,** an English sculptor, born at Blandford, Dorsetshire, in 1817, died in 1875. He showed a talent for painting when a child, and at the age of 16 went to Florence and studied the works of Salvator Rosa; afterward in Rome he became a pupil of Thorwaldsen. In 1843 he returned to England, and was connected with the art schools of Somerset house. In 1850 he removed to Sheffield, where he devoted his time to decorative work in iron and silver. He designed innumerable objects of daily use in the finest taste, with which the name of the manufacturer rather than the designer is associated; the most noticeable of these are the sejant lions on the iron posts before the grille of the British museum. In 1857 he received the commission from government for the monument to the duke of Wellington in St. Paul's cathedral. The sum voted for it by parliament (£14,000) was inadequate for carrying out his design, and he spent much of his private means upon it; and after 18 years of labor, he died leaving it incomplete. He executed several admirable portrait busts, and the mosaic "Isaiah" in the arch of the dome of St. Paul's.

**STEVENS, Alfred,** a Belgian painter, born in Brussels in 1828. He was a pupil of Navez in Belgium, and of Roqueplan at Paris. His specialty is modern costumes, furniture, and elegances, and his pictures command large prices. His "New Year's Gift" was sold in Brussels in 1874 for £840, and "Springtime of Life" in New York in 1878 for $1,050. Among his other works are "The Visit," "La Dame Rose," "Consolation," "Innocence," "Ophelia," "A Duchess," "A Morning in the Country," "The Bath," "The Japanese Woman," and "The Surprise." He has exhibited his pictures in Brussels and Paris since 1849.

**STIRLING, James Hutchinson,** a British author, born in Glasgow, June 22, 1820. He was educated at Glasgow university, and became a surgeon, but in 1851 abandoned his profession and went to the continent to study German philosophy and literature. He returned to England in 1857. He has published "The Secret of Hegel" (1865); "Sir William Hamilton on the Philosophy of Perception" (1865); "Schwegler's History of Philosophy, Translated and Annotated" (1867); "Jerrold, Tennyson, and Macaulay, with other Critical Essays" (1868); "Address on Materialism" (1868); "As regards Protoplasm," in which he combats the theory (1869); "Lectures on the Philosophy of Law" (1873); and "Burns in Drama, together with Faded Leaves" (1878).

**STONE, Marcus,** an English painter, born in London in 1840. He is a son of Frank Stone, worked in his father's studio, and became known as a skilful designer and painter of pieces of historic genre. His works include "Rest," "Silent Pleadings," "The Sword of the Lord and Gideon," "Claude accuses Hero," "The Painter's First Work," "On the Road from Waterloo to Paris," "Working and Shirking,"

"Old Letters," "Stealing," "Nell Gywnne," "The Interrupted Duel," "Henry VIII. and Anne Boleyn observed by Queen Katharine," "The Royal Nursery in 1838," "Edward II. and Piers Gaveston," "My Lady is a Widow and Childless," "Sain et Sauf," "Rejected," "The Sacrifice," "Waiting at the Gate," "The Post Boy," and "The Time of Roses." His "Childless Widow" was at the Philadelphia exhibition of 1876.

**STOREY, George Adolphus,** an English painter, born in London in 1834. At the age of 12 he won a prize for painting in oil. He studied mathematics in Paris from 1848 to 1850, painting in the Louvre as occasion offered, and afterward studied art in London. In 1863 he went to Spain to study and paint. He is particularly happy in his portraits of children and girls. His works include "A Family Portrait," "Madonna and Child," "Holy Family," "Sacred Muse," "The Widowed Bride," "The Bride's Burial," "The Annunciation," "Meeting of William Seymour and Lady Arabella Stuart in 1609," "The Royal Challenge," "After You!" "The Shy Pupil," "Saying Grace," "Going to School," "The Old Soldier," "The Duet," "Only a Rabbit," "Rosy Cheeks," "Lessons," "Little Buttercups," "The Course of True Love," "Love in a Maze," "Mistress Dorothy," "Grandma's Christmas Visitors," "Caught," "The Whip Hand," "A Dancing Lesson," "My Lady Belle," "The Old Pump Room at Bath," "The Judgment of Paris," "Christmas Eve," and "Sweet Margery."

**STRATEGOS** (Gr. στρατός, an army, and ἄγω, to lead), the American game of war. This title broadly comprehends a series of six independent military games, or more strictly studies, of gradually increasing interest and importance. It was invented by Lieut. C. A. L. Totten of the 4th U. S. artillery, its first inception dating back to 1875, when its elementary applications were employed in the military department of the Massachusetts agricultural college, then under his charge. The completed work was not made generally public until 1879, when it was submitted to joint boards of regular army and national guard officers, in San Francisco, Cal., by whom it was recommended for adoption in all branches of the American service. Strategos is the first American effort at the solution of the same great problem that has so long been studied abroad under the familiar titles of "Kriegsspiel," "Aldershott," "the war game," &c. But there is a radical difference between the American and foreign systems. The latter are designed for the almost exclusive use of the best informed and most advanced members of the military profession. Strategos is both an advanced game and an elementary one.—THE OUTFIT may be divided into four parts, to wit: 1, a set of military pieces, red and blue; 2, a set of tactical and topographical blocks; 3, an assortment of special appliances of varying use in one or all of the several games; 4, a text book. The military pieces represent the more important tactical units (such as regiments, batteries, and squadrons) of two independent armies, one red, the other blue, with their trains, baggage, standards, general officers, &c. The infantry, cavalry, and artillery pieces are distinguished by their insignia and shape. These pieces are all made accurately to a scale of 10 inches to the mile. They are made of wood, and have a silicate-slate surface, prepared for the purpose of receiving such marks, indicative of losses, varying condition, results, consequences, &c., as the players may see fit to put upon them. The tactical and topographical blocks, made of thin rectangular strips of wood, are all about an eighth of an inch thick, from one to eight inches in length, and from one to six inches in width. Each of these pieces is slated upon one of its faces, called the tactical side, half of them in red and the other half in blue. Upon their reverse or topographical sides, rivers, mountains, swamps, villages, lakes, &c., are depicted. This division of the outfit is employed particularly in the three lower games, though parts of it come into play in all the applications of strategos. The special appliances consist of numerous scales, dividers, calipers, dice, counters, slated game boards, colored pencils, &c. The text book contains the rules for the use of the outfit, and minutely describes its employment in each of its several applications. It also serves as a sort of general military handbook.—APPLICATIONS OF THE OUTFIT. The several parts into which the game of strategos is arranged are as follows: 1, the minor tactical game; 2, the grand tactical, strategical, and topographical game; 3, military text-book illustration; 4, military history; 5, the battle game; 6, the advanced game. 1. *The Minor Tactical Game.* The second part of the outfit is employed in this division. During the first studies of a recruit the various tactical pieces will enable him or his instructor to exemplify promptly and clearly the positions and movements of officers and men in all the manœuvres of any arm of the service. The colored slated sides of the several pieces are to be turned up in this branch of the study, and according to their size they are to be employed to represent sets of twos or fours, platoons, companies, &c. The student himself must designate and employ these pieces to suit his own necessities. For instance, the various officers and non-commissioned officers of a company may be designated by name or insignia upon some of the slated disks, and the same pieces, properly numbered, may in turn represent the individuals in a set of fours, complete or incomplete, a gun detachment, &c. Again, two of the 4×2-inch pieces, joined together and marked respectively "1st platoon" and "2d platoon," will, with the requisite quota of officers, represent a company arranged for the study of the simpler movements in "the school of the platoon." And so on, upward and downward, through the several "schools" of "the three arms."

2. *The Grand Tactical, Strategical, and Topographical Games.* A portion of the blocks are now turned over so as to expose their reverse sides, upon which the various topographical features are depicted. They are then to be used in conjunction with others left with their tactical sides up, to illustrate the various principles of strategy, affording to the numerous text books and authorities upon these subjects the same ready illustration that, with only their tactical sides up, they do to the manuals of tactics. The student can employ the various parts of the outfit in practically illustrating any of the conditions and problems of field service in time of war, such as camping, cantoning, establishing outposts, grand guards, sieges, &c. The topographical capacity of the outfit is such that it affords an inexhaustible source of ready illustration for every text book and authority. 3. *Military History.* Strategos affords companionship to those who are interested in the study of military history. Battles and campaigns can be analyzed with its assistance, and followed step by step and detail by detail, with a clearness which would be utterly impossible even with the most extensive system of maps and diagrams alone. 4. *The Battle Game.* Upon the large slated game board two armies of any size and organization can be represented, with proper regard to lines, distance, and order of battle. Every squadron, battery, and regiment is represented by a separate piece; and, the various "orders" having special moves and powers, and the whole progress of the game being governed by carefully compiled rules, a miniature battle can be fought upon theoretical principles, that is far less trying to ordinary patience than the advanced game, and yet one which educates the players up thereto. The following is an outline of the order of procedure in playing the battle game: 1. Two or more players agree upon the number of men to be employed upon each side, the character of battle to be fought, &c. 2. The proper division of troops is made among the three arms, and the two armies organized. 3. Each player makes his dispositions in battle array behind a screen stretched across the middle of the game board. 4. A *coup d'œil* reconnoissance is allowed to each player, and any unmilitary dispositions of the hostile army are challenged. 5. Rearrangements due to this reconnoissance are now effected. 6. The screen is drawn aside, and the players, moving alternately a number of pieces at once, advance their armies into action. 7. Skirmishing begins. 8. The general engagement comes on. 9. The victory is decided by one or the other side capturing a majority of the hostile colors. 10. Final dispositions are made, and the course of the game studied and discussed. The battle game is really a compromise between a game and a study, between chess and "war upon the map." Its various features are calculated with special reference to the subject illustrated. The rules of the game conspire toward concentration and arrangement as a means of securing victory, rather than toward captures and losses, the aim being to make these rules suggestive of military ideas. 5. *The Advanced Game.* This is a direct attempt at the solution of the science of strategy as defined by Jomini, and constitutes the highest form of military study. Sixty or more extensive tables, filled with military statistics, the use of which is covered by copious rules, are contained in the accompanying text book. These tables extend over the various questions of transportation, marches, casualties in field and camp, time required for various purposes, results of victory, consequences of defeat, &c. The deep analysis of the circumstances of action required in such an investigation gives the student an intimate acquaintance with the details of engagements and campaigns that in time of peace must otherwise remain neglected. In this branch of the subject all arbitrary assignments of values and moves are of course entirely out of the question and improper. The whole study is required to base itself upon actualities, upon the results of careful investigations, and upon tabulated statistics gathered from former battles and campaigns.

**SULLIVAN, Barry**, an English actor, born in Birmingham in 1824. He made his début at Cork in 1840, with great success. He then spent some time in study in Ireland, after which he played for several seasons at the Theatre Royal in Edinburgh. He next made a tour of the provinces, and in November, 1851, played Hamlet at the Haymarket in London. He afterward appeared in succession at the St. James, Sadler's Wells, Standard, and Drury Lane. In the autumn of 1857 he crossed the sea, and in the next two years and a half made the tour of the United States and Canada. In 1860 he made a tour in Great Britain and Ireland, and in 1861 sailed for Australia, where he met with extraordinary success, playing nearly 1,000 nights in Melbourne. He returned to England in the summer of 1866. and in the following season reappeared at Drury Lane, playing Richard III., Macbeth, Hamlet, and other Shakespearian characters.

**SUMBUL, or Musk Root**, a perennial, umbelliferous plant, growing to the height of 8 or 10 ft., and by Hooker named *forula sumbul* (*euryangium sumbul*, Kaufmann). Sumbul root was introduced into Russia about 1830, as a substitute for musk; but the plant itself was not known until 1869, when it was discovered by a Russian traveller in the mountains of Maghian, eastward of Samarkand. Since then specimens have flowered in the botanical gardens of Moscow and Kew. The root, as found in commerce, is in transverse slices, two to five inches in diameter, and from three quarters to an inch and a half thick. It has a strong odor, resembling that of musk, and a taste which is at first sweetish, but afterward bitterish and balsamic. Sumbul is a stimulant, tonic, and carminative, and may be used as a substitute

for musk in nervous affections, as hysteria, spasmodic asthma, epilepsy, &c. It is best administered in the form of tincture, made by macerating two and a half ounces of the root in a pint of dilute alcohol, of which the dose is from 10 to 40 drops.

**SUN.**—*Minute Structure of the Photosphere.* When the sun is viewed with the naked eye, or with a telescope of low power, it presents a uniform bright, shining surface, called the "photosphere." With a telescope of higher power the photosphere is seen to be diversified with groups of spots, and under good conditions the whole mass has a mottled or curdled appearance. This mottling is caused by the presence of cloud-like forms, whose outlines, though faint, are distinguishable. The background is also covered with small white dots or forms still smaller than the clouds; these are called "rice grains." The clouds themselves are composed of small, intensely bright bodies, irregularly distributed, of somewhat definite shapes, which seem to be suspended in or superposed on a darker medium or background. The spaces between the bright dots vary in diameter from 2″ to 4″ (about 875 to 1,750 miles). The rice grains themselves have been seen to be composed of smaller granules, sometimes not more than 0·3″ (135 miles) in diameter, clustered together. Thus there have been seen at least three orders of aggregation in the brighter parts of the photosphere: the larger cloud-like forms; the rice grains; and, smallest of all, the granules. These forms have been studied with the telescope by Secchi, Huggins, and Langley, and their relations tolerably well made out. In the *Annuaire* of the bureau of longitudes for 1878, M. Janssen gives an account of his recent discovery of the reticulated arrangement of the solar photosphere. The paper is accompanied by a photograph of the appearances described, which is enlarged threefold. Photographs less than four inches in diameter cannot satisfactorily show such details. As the granulations of the solar surface are, in general, not greatly larger than 1″ or 2″, the photographic irradiation, which is sometimes 20″ or more, may completely obscure their characteristics. This difficulty M. Janssen has overcome by enlarging the image and shortening the time of exposure. "The photograms show that the constitution of the photosphere is not uniform throughout, but that it is divided into a series of regions more or less distant from each other, and having each a special constitution. These regions have, in general, rounded contours, but these are often almost rectilinear, thus forming polygons. The dimensions of these figures are very variable; some are even 1′ in diameter (over 25,000 miles)." "Between these figures the grains are sharply defined, but in their interior they are almost effaced and run together as if by some force."—*Solar Spots.* Dr. Wolf, director of the Zürich observatory, has collected observations of the solar spots, and finds that since 1610 we have a nearly complete record of these appearances. The number and character of the spots are now noted every day by observers in many quarters of the world. This long series of observations has served as a basis to determine each epoch of maximum and minimum which has occurred since 1610, and thence to determine the length of each single period. The following table gives the times of maximum and minimum sun-spot frequency, according to Wolf:

| First Series. | | | | Second Series. | | | |
|---|---|---|---|---|---|---|---|
| Minima. | Diff. | Maxima. | Diff. | Minima. | Diff. | Maxima. | Diff. |
| A. D. | Yrs. | A. D. | Yrs. | A. D. | Yrs. | A. D. | Yrs. |
| 1610·8 | | 1615·5 | | 1745·0 | | 1750·3 | |
| | 8·2 | | 10·5 | | 10·2 | | 11·2 |
| 1619·0 | | 1626·0 | | 1755·2 | | 1761·5 | |
| | 15·0 | | 13·5 | | 11·3 | | 8·2 |
| 1634·0 | | 1639·5 | | 1766·5 | | 1769·7 | |
| | 11·0 | | 9·5 | | 9·0 | | 8·7 |
| 1645·0 | | 1649·0 | | 1775·5 | | 1778·4 | |
| | 10·0 | | 11·0 | | 9·2 | | 9·7 |
| 1655·0 | | 1660·0 | | 1784·7 | | 1788·1 | |
| | 11·0 | | 15·0 | | 13·6 | | 16·1 |
| 1666·0 | | 1675·0 | | 1798·3 | | 1804·2 | |
| | 13·5 | | 10·0 | | 12·3 | | 12·2 |
| 1679·5 | | 1685·0 | | 1810·6 | | 1816·4 | |
| | 10·0 | | 8·0 | | 12·7 | | 13·5 |
| 1689·5 | | 1693·0 | | 1823·3 | | 1829·9 | |
| | 8·5 | | 12·5 | | 10·6 | | 7·3 |
| 1698·0 | | 1705·5 | | 1833·9 | | 1837·2 | |
| | 14·0 | | 12·7 | | 9·6 | | 10·9 |
| 1712·0 | | 1718·2 | | 1843·5 | | 1848·1 | |
| | 11·5 | | 9·3 | | 12·5 | | 12·0 |
| 1723·5 | | 1727·5 | | 1856·0 | | 1860·1 | |
| | 10·5 | | 11·2 | | 11·2 | | 10·5 |
| 1734·0 | | 1738·7 | | 1867·2 | | 1870·1 | |
| Years. 11·20±2·11 ±0·64 | | Years. 11·20±2·06 ±0·63 | | Years. 11·11±1·54 ±0·47 | | Years. 10·94±2·52 ±0·76 | |

From the first series of earlier observations, the period comes out from observed minima 11·20 years, with a variation of two years; from observed maxima the period is 11·20 years, with a variation of two years; that is, this series shows the period to vary between 13·3 and 9·1 years. If we suppose these variations to arise only from errors of observation, and not to be real changes of the period itself, the mean period is 11·20 ± 0·64. The results from the second series are also given at the foot of the table. From a combination of the two, it follows that the mean period is 11·111 ± 0·307 years, with an oscillation of ± 2·030 years. These results are formulated by Dr. Wolf as follows: The frequency of solar spots has continued to change periodically since their discovery in 1610; the mean length of the period is 11⅑ years, and the separate periods may differ from this mean period by as much as 2·03 years.—A connection between the amount of the surface of the sun covered with spots (the spotted area) and the declination of the magnetic needle has been supposed to exist. This connection was first suggested by Gen. Sabine, and the question has been most carefully examined by Dr. Wolf of Zürich, who each year predicts from the observations of sun spots what will be the magnetic declination at Prague, Munich, &c. It may be said that

there is no doubt of the connection. The sun-spot cycle and the cycle through which the variations of the magnetic declination run are about the same ($11\frac{1}{9}$ years). Mr. Ellis of the Greenwich observatory has recently worked up the Greenwich magnetic observations from 1841 to 1877, including not only the variations of the magnetic declination, but those of the horizontal force. The observations of vertical force are not used, since the instruments have not been the same throughout the period, and for other reasons. "The following are the general conclusions derived from the whole inquiry: 1. That the diurnal ranges of the magnetic elements of declination and horizontal force are subject to a periodical variation, the duration of which is equal to that of the known eleven-year sun-spot period. 2. That the epochs of minimum and maximum magnetic and sun-spot effect are nearly coincident; the magnetic epochs, on the whole, occurring somewhat later than the corresponding sun-spot epochs. The variations of duration in different periods appear to be similar for both phenomena. 3. That the occasional more sudden outbursts of magnetic and sun-spot energy, extending sometimes over periods of several months, appear to occur nearly simultaneously, and progress collaterally. 4. That it seems probable that the annual inequalities of magnetic diurnal range are subject also to periodical variation, being increased at the time of a sun-spot maximum, when the mean diurnal range is increased, and diminished at the time of a sun-spot minimum, when the mean diurnal range is diminished. Conclusions Nos. 1, 2, and 3 appear to be sufficiently certain, but the evidence in favor of No. 4 is not so decisive. The magnetic results have been published from time to time in the 'Greenwich Observations,' as also have Dr. Wolf's results in his *Astronomische Mittheilungen*. The thorough independence of the data is thereby assured." This new and thorough investigation seems to show a certain relation between the spotted area and the magnetic elements, and, with the connection shown by Hornstein to exist between the rotation period of the sun and the 26-day period of the magnetic declination, seems to make it certain that there is a connection between the sun and earth.—It is found from direct measures that a sun spot gives less heat, area for area, than the unspotted photosphere; and it is an interesting question how much the climate of the earth can be affected by this difference. Prof. Langley of Pittsburgh has lately made measurements of the direct effect of sun spots on terrestrial temperature. The observations consisted in measuring the relative amounts of umbral, penumbral, and photospheric radiation. The relative umbral, penumbral, and photospheric areas were deduced from the Kew observations of spots; and from a consideration of these data, and confining the question strictly to changes of terrestrial temperature due to this cause alone, Langley deduces the result that sun spots exercise a direct effect on terrestrial temperature by decreasing the mean temperature of the earth at their maximum. This change is very small, as "it is represented by a change in the mean temperature of our globe in eleven years not less than 0·3° C. and not greater than 0·5° C." It is not intended to show that the earth is, on the whole, cooler in maximum sun-spot years, but that, so far as this cause goes, it tends to make the earth cooler by this minute amount.—*Solar Spectrum.* Capt. Abney, F. R. A. S., is said to have obtained pictures of the solar spectrum in its natural colors, both on silver plates and on compounds of silver held *in situ* by collodion. The photographs are produced by oxidation of silver compounds when placed in the spectrum, the coloring matter being due apparently to a mixture of two different sizes of molecules of the same chemical composition, one of which absorbs at the blue end and the other at the red end of the spectrum; and the sizes of these molecules are unalterable while exposed to the same wave lengths as those by which they were produced. Capt. Abney believes that the colors may be preserved unchanged when exposed to ordinary daylight. He has thus succeeded in explaining the action by which Becquerel some years ago obtained photographs in colors, as produced by oxidation and not due to interference.—*Oxygen in the Sun.* Certain elements, among them oxygen, have not been detected in the sun by the ordinary spectroscopic methods. In 1877 Dr. Henry Draper of New York published an account of his discovery, by photographs of the spectrum, of the presence of oxygen in the solar photosphere (not chromosphere). This was shown by the coincidence of the bright lines of the oxygen spectrum with certain bright lines in the solar spectrum. To be accepted as proof, the commonly received theory of the solar spectrum had to be modified. The usual conception has been, that the latter is a uniform continuous spectrum, crossed by dark lines, and containing dark lines only. Dr. Draper's idea is, that it also contains bright lines, and some of these coincide accurately with the bright lines of oxygen. The question is still unsettled, as Dr. Draper's view is combated by various spectroscopists on grounds of observation. At present, however, the presumptions from observation are in his favor, as his photographs have been repeated in a great variety of ways, and always with the same result. Theoretically it may be said that, supposing every substance except oxygen to exist in the spectrum, the result would be to give bright spaces in the spectrum in the places of the oxygen lines; for all the rest of the spectrum would be fainter, owing to the presence of the lines of the other substances.—*Solar Corona.* Prof. Tacchini records a remarkable view of the corona at Palermo, July 29, 1878, under very favorable atmospheric conditions. He hid the disk of the sun,

and saw the corona so distinctly that he made a sketch of it, which agrees remarkably with a drawing made on the same day in America by P. Sestini during the eclipse. At Palermo the corona was of course seen without the intervention of an eclipse, and the rays and streamers appear to have been distinctly traced to a distance of 1¼° from the sun's centre on the one side, and of ¾° on the other. This observation, as regards the extent to which the corona was visible, is unique; though Mr. Brett many years ago declared that the corona could be seen near the sun without an eclipse, and many observers have seen it as a bright background on which Venus and Mercury stood out as black disks outside the sun's limb at the late transits.—*Solar Parallax.* The first really successful measure of the parallax of a planet was made upon Mars during the opposition of 1672. An expedition was sent to the colony of Cayenne to observe the declination of the planet from night to night, while corresponding observations were made at the Paris observatory. From a discussion of these observations, Cassini obtained a solar parallax of 9·5″, which is within a second of the truth. The next steps forward were made by the transits of Venus in 1761 and 1769. The leading civilized nations caused observations on these transits to be made at various points on the globe. The method used was very simple, consisting in the determination of the times at which Venus entered upon the sun's disk and left it again. The absolute times of ingress and egress, as seen from different points of the globe, might differ by 20 minutes or more on account of parallax. The results, however, were found to be discordant. Half a century later the observations were all carefully calculated by Encke of Germany, who concluded that the parallax of the sun was 8·857″, and the distance 95,000,000 miles. In 1854 it began to be suspected that Encke's value of the parallax was much too small. Hansen, from the parallactic inequality of the moon, first found the parallax of the sun to be 8·97″, a quantity which he afterward reduced to 8·916″. This result seemed to be confirmed by other observations, especially those of Mars during the opposition of 1862. It was therefore concluded that the sun's parallax was probably between 8·90″ and 9″. Subsequent researches have been diminishing this value. In 1867, from a discussion on all the data which were considered of value, it was concluded by Prof. Newcomb that the most probable parallax was 8·848″. The measures of the velocity of light made by Michelson in 1878 reduce this value to 8·81″, and it is now doubtful whether the true value is any larger than this. The observations of the transit of Venus in 1874 have not been completely discussed. But it is to the determination of the velocity of light that we are to look for the best result. If we wish to express the constants relating to the sun in round numbers, we may say that its mass is 330,000 times that of the earth, and its distance in miles is 93,000,000, or perhaps a little less. Mr. D. P. Todd, of the "American Ephemeris," published in January, 1880, a deduction of the parallax of the sun from all the data now at our disposal. Recent determinations of the velocity of light, in kilometres per second, are as follows: by Foucault (1862), 298,000; Cornu (1874), 298,500; Cornu (1876), 299,990; Michelson (1878), 300,100; Michelson (1879), 299,930. From a discussion of the observations, the resulting velocity is concluded to be 299,920 kilometres, or 186,360 miles. Combining this result with the observations of the satellites of Jupiter, the resulting parallax is 8·802″; combining with Struve's constant of aberration, it is 8·811″. The most probable result is 8.808″ ± 0·006″, corresponding to a distance of the sun of 92,800,000 miles.—*Solar Temperature.* Observers have made very wide differences in estimating the temperature of the sun's visible surface; often their estimates are based on the same or similar experiments, and the discrepancies arise from assumptions concerning the (unknown) laws governing solar action, which is analogous to certain physical actions observable on the earth. For example, the solar temperature is put by Sir John Herschel at 9,000,000° F., while Secchi made it 239,000°. M. Violle has made it 2,800°. Prof. Langley, of the Allegheny observatory, has taken a ready and practical means of comparing the solar temperature with that of the largest available surface of intensely heated matter, viz., the contents of a Bessemer steel converter at the Pittsburgh steel works. He compared the radiation from this mass with that from the solar disk directly, and comes to the conclusion that the heat radiation from the sun "is at least 100 times that from melted platinum, area for area, and it may be much more." That is, the average temperature of the sun's photosphere is at least more than 300,000° F., and it may be vastly more.—*Solar Eclipses.* The total eclipse of July 29, 1878, was more fully observed than any previous one, and it is probably not too much to say that the results to be derived from it will be of correspondingly greater value. The line of total eclipse passed diagonally across the United States, from the northwest border through Denver and Texas, and again through Havana. Several persons came from England to observe it; various colleges and observatories in the United States sent parties; many private observers went at their own expense; the signal bureau sent expeditions, and received reports from their western stations; and finally the naval observatory sent several of its own observers and many other parties, whose expenses were defrayed either wholly or in part by the liberal appropriation of $8,000 made by congress for the purpose; 27 such observers were thus provided for. Some of the results of special parties have already been published, as

those of Prof. Young of Princeton and the Fort Worth party; but the main work will be issued in 1880 by the naval observatory, and will contain the results gained by the expenditure of the appropriation mentioned. The main results, as far as known at this time, may be summed up as follows: The brightness of the corona was much less than at previous eclipses; this perhaps is connected with the generally quiescent condition of the sun's surface as to spots, protuberances, &c. The spectrum of the corona was materially altered from its nature in 1869 or 1870. Bright lines were its chief characteristic in 1869, and in all subsequent eclipses till 1878, when they were so faint as only to be seen by a few of the spectroscopists, the majority seeing only a continuous spectrum. The 1474 line and the hydrogen lines were certainly present all the time, as shown by the observations of Profs. Young, Thomas, and Eastman. The last traced the 1474 line all around the sun to a distance of 10′ to 20′ from the limb. No new bright lines in the coronal spectrum were found, either by photography or spectroscopy. Prof. Rockwood observed a chromospheric line (534 of Kirchhoff's scale), thus confirming an observation of Pogson's in 1868. The line has no corresponding dark line in the solar spectrum, and, like the "helium" line, probably corresponds to an unknown substance. Calcium was also proved to exist in the sun, thus confirming Prof. Young's observation at Sherman in 1872. Dark lines in the spectrum of the corona were seen by various observers, particularly by Prof. Barker of Philadelphia. This shows that some of the coronal light is merely reflected sunlight. The polarization of the corona was examined by several observers, notably Prof. Wright of New Haven, Mr. Ranyard of England, and Dr. C. S. Hastings of Baltimore. The eye observations of Mr. Ranyard and others, and the photographs of Mr. Wright, show a radial polarization. Mr. Hastings's result is directly opposite, giving tangential polarization; and the care with which his observations were made does not allow them to be at once rejected. The next total eclipse may settle the question finally. The weight of evidence is now in favor of radial polarization. Mr. Edison invented a delicate machine, the microtasimeter, for measuring the heat of the corona; but it was found to be too sensitive for the purpose. While the nature of the coronal spectrum was so essentially changed from its former one, the change can be entirely accounted for by a different distribution of the materials of which the corona is composed. In 1869–'75 the gaseous materials were high above the solar surface; their lines were bright and were observed, overlooking the faint continuous spectrum. In 1878 the opposite conditions prevailed: 1869–'75 was a period of activity in the solar surface; 1878 was near the minimum of sun spots and protuberances. The extent of the outer (and faint) corona was remarkable. Prof. Holden traced it 2½° each side of the sun with a telescope; Profs. Newcomb and Langley traced it 6° each side with the naked eye. It is by the excellent photographs of the corona that this eclipse will be distinguished as so great an advance over previous ones. Prof. Hall and Prof. Harkness made photographs of the corona with large equatorial cameras, and took each five or more negatives, with exposures of 3 to 60 seconds. The dry plates for these were specially prepared by Mr. J. A. Rogers of the naval observatory. The short-exposure photographs give details of the corona close to the sun; as the exposure was increased, the parts near the sun were gradually effaced, but new details further out were added. So, finally, the negatives of $1^m_4$ exposure give details to about 20′ from the sun. These negatives show the sun 0·36 inch in diameter. The photograph of the corona taken by Prof. Holden's party admirably supplements those of Profs. Hall and Harkness. It has no minute details, but shows the limits of the corona out to 70′ from the sun. By combining these sets, the whole shape of the corona is well shown from the limb to 70′. The details are well given out to 16′–20′. Each negative allows a contour line of equal light to be drawn. It should be said that the two sets of Prof. Hall and Prof. Harkness agree between themselves, and thus show that the corona itself did not change between the times of totality at the two stations. Drawings of the corona were made by many observers. They exhibit between themselves the astonishing differences which have characterized similar drawings at other eclipses. By comparing them, however, with the corona as constructed by means of the photographs of the naval observatory, these apparently irreconcilable differences are harmonized. Each observer saw something, and drew it with tolerable correctness. Probably no one observer saw all the features; but whatever was drawn, in nearly every case, was an important and integral part of the real phenomenon. The dark rifts between bright streamers of the corona which have been frequent at other eclipses were represented by only one feature of this kind. It is shown on the negatives, and was drawn by Profs. Boss and Holden.

**SWIFT, Lewis**, an American astronomer, born in Clarkson, N. Y., Feb. 29, 1820. At the age of 13 the breaking of his leg, and an unskilful setting of it, rendered him a cripple; to which circumstance he is indebted for a better education than he would otherwise have received. In 1846 he began the study of electricity and magnetism, and during the next four years lectured on those subjects in Canada and the western states. Afterward he lectured for some time upon the "wonders of the microscopic world," illustrated by means of a calcium light. All of his apparatus was constructed by himself, and parts of it were his own invention. In 1854 he set up a hardware store in Cortland county, N. Y., which in 1872 he removed to Rochester, where he still resides (1880). He began

the study of astronomy in 1855, and made himself a 3-inch telescope. When the object glass was accidentally broken, he bought one of 4½ inches apèrture, and with this all his subsequent work has been done. He has devoted himself specially to comet-seeking, and was the first discoverer of the great comet of 1862, which was seen two days later from Cambridge observatory, and not till ten days later in Europe. In 1869 he discovered another comet, but had been anticipated eight days by a European observer. Two years later he saw a comet for two minutes, when clouds intervened, and it was not seen again by him or any other observer. He was an independent discoverer of the great comet of 1874, but was anticipated by Coggia. He discovered three comets in the years 1877, 1878, and 1879, for which the imperial academy of sciences at Vienna has awarded him three gold medals. But one other such medal has ever been awarded to an American for discovery of a comet. At Denver, Colorado, during the solar eclipse of 1878, Mr. Swift discovered two intra-Mercurial planets. A wealthy citizen of Rochester, Mr. H. H. Warner, is building him an observatory and residence, at an expense of $25,000; and money has been raised by private subscription for a 16-inch telescope, which is now (1880) nearly completed. Mr. Swift is a fellow of the royal astronomical society of England, and has published numerous papers.

**SWING, David**, an American clergyman, born in Cincinnati, O., Aug. 23, 1830. He graduated at Miami university, Oxford, O., in 1852, and studied theology, but became principal of the classic grammar school of the institution, in which he taught Greek and Latin for twelve years, preaching occasionally. In 1866 he became pastor of a Presbyterian church in Chicago. For several years he was looked upon as an independent thinker, but not as holding any views that would justify a charge of unsoundness in doctrine. In May, 1874, however, he was formally arraigned by the most conservative party in the church, and was tried for heresy on thirty specifications. He was acquitted by the presbytery; but as the prosecution appealed the case to the synod, thus threatening the accused with further annoyance, he withdrew from the Presbyterian body, and entered upon duty as a Congregational (independent) minister. He is now (1880) acting pastor of the Central church, Chicago. He has been for several years one of the editors of "The Alliance," a religious journal, and has published several volumes of sermons, and a volume of "Club Essays" (1880).

**TAILLANDIER, René Gaspard Ernest** (called SAINT-RENÉ), a French author, born in Paris, Dec. 16, 1817. He was educated in Paris and at the university of Heidelberg, was for two years assistant professor of literature at Strasburg, became in 1846 professor at Montpellier, and in 1863 was transferred to the Sorbonne, where in 1868 he received the chair of French eloquence, which he still holds (1880). He has been general secretary of the ministry of public instruction, a councillor of state, and a member of the superior council of special secondary education, and in 1873 was elected to the French academy. In 1875 his lectures on French literature and eloquence at the time of the revolution created disturbances among the students, who resented his remarks on Danton, Robespierre, and other republican leaders. His publications include *Béatrix*, a poem (1840); *Des écrivains sacrés au XIXe siècle* (1842); *Scott Érigène et la philosophie scolastique* (1843); *Histoire de la jeune Allemagne, études littéraires* (1849); *Études sur la révolution en Allemagne* (2 vols., 1853); *La promenade du Peyron et la cathédrale de Montpellier* (1854); *Allemagne et Russie, études historiques et littéraires* (1856); *Histoire et philosophie religieuse* (1860); *Littérature étrangère, écrivains et poëtes modernes* (1861); *La Comtesse d'Albany* (1862); *Lettres inédites de Sismondi* (1863); *Maurice de Saxe* (2 vols., 1865); *Drames et romans de la vie littéraire* (1869); and *La Serbie au XIXe siècle: Kara George et Miloch* (1875).

**TATKELEFF, Vogisny**, a Russian painter, born about 1813. He is the son of a serf, whose master, seeing the talent Tatkeleff displayed in some rude charcoal sketches, determined upon educating him. At the age of 19, however, he, with his benefactor's estate, passed into other hands, and he was forced to serve for 15 years in the army. Only during the last two years did he have any opportunity to practise with his brush; then he was permitted to fresco the walls of the dining room of a relative of his colonel, while stationed at Tiflis. On going home after his discharge in 1849, he found his parents and master dead; but the widow of the latter furnished him with the means to pursue his studies, only stipulating that he should not leave Russia, and that she should have the choice of his works. In 1854 he went with her son to the Crimean war, where his eyesight was seriously impaired. During this time his benefactress died; and as her son would do nothing for him, he supported himself by making designs for a publishing house at Kiev. He received encouragement from a tourist who saw his sketch book to send something to Moscow for exhibition, and after a long struggle procured the necessary materials for his two great pictures, representing scenes in the Crimean war; these he sent to the art exposition in Moscow of 1873, and they at once lifted him from obscurity and poverty to fame and wealth, being bought for the gallery of the winter palace, St. Petersburg, for 60,000 roubles.

**TELESCOPES.** One of the largest recent reflecting telescopes is that made by M. Martins for the Paris observatory. Its aperture is 120 centimetres (almost 4 ft.). Its mirror is made

## I. REFLECTORS.

One French inch = 12 Paris lines; one English inch = 11·26 Paris lines; one metre = 443·30 Paris lines.

| OWNER OR DIRECTOR, AND OBSERVATORY. | Constructed by | APERTURE. English feet or inches. | APERTURE. French inches. | APERTURE. Metres. | FOCAL LENGTH. English feet. | FOCAL LENGTH. French feet. | FOCAL LENGTH. Metres. | REMARKS. |
|---|---|---|---|---|---|---|---|---|
| Lord Rosse, Birr Castle....... | Rosse.............. | 6 ft. | .... | .... | 55 | .... | .... | Erected 1844. |
| Bessemer, London............ | Bessemer.......... | 50½ in. | .... | .... | .... | .... | .... | Silvered glass (constructing). |
| W. Herschel, Slough.......... | W. Herschel....... | 4 ft. | .... | .... | 40 | .... | .... | Out of use. |
| Lassell, Liverpool, etc........ | Lassell............ | 4 ft. | .... | .... | 37 | .... | .... | Since destroyed. |
| Ellery, Melbourne............ | Grubb.............. | 4 ft. | .... | .... | 32 | .... | .... | Erected 1870. |
| Observatory, Paris........... | Martin, Eichens .... | .... | .... | 1·20 | .... | .... | 7 | Silvered glass. |
| Common, Ealing.............. | Calver......... .... | 37·5 in. | .... | .... | 20 | .... | .... | Silvered glass. |
| Lord Rosse, Birr Castle....... | Rosse.............. | 36 in. | .... | .... | .... | .... | .... | |
| Observatory, Toulouse........ | Foucault........... | ..... | .... | 0·80 | .... | .... | .... | |
| Stephan, Marseilles........... | Foucault, Eichens .. | ..... | .... | 0·80 | .... | ... | 4·80 | |
| H. Draper, near New York... | H. Draper.......... | 28 in. | .... | .... | 13 | .... | .... | Silvered glass. |
| Lassell, Maidenhead.......... | Lassell............ | 24 in. | .... | .... | 20 | .... | .... | Metal. |
| Schröter, Lilienthal........... | Schräder........... | 19¼* | .... | .... | .... | 25 | .... | Made in 1794. |
| Herschel, Slough, and C. G. H. | Herschel........... | 18 in. | .... | .... | 20 | .... | .... | Several mirrors. |
| H. Draper, near New York... | H. Draper.......... | 15 in. | .... | .... | .... | .... | .... | Silvered glass. |
| Maclean, Tunbridge Wells.... | With, Browning.... | 15 in. | .... | .... | .... | .... | .... | |
| Pritchard, Oxford............. | De la Rue.......... | 13 in. | .... | .... | 10 | .... | .... | |
| Worthington and Baxendell, Manchester................ | With, Browning?... | 13 in. | .... | .... | .... | .... | .... | |

## II. REFRACTORS.

| OWNER OR DIRECTOR, AND OBSERVATORY. | Constructed by | APERTURE. English Inches. | APERTURE. French inches. | APERTURE. Metres. | FOCAL LENGTH. English feet. | FOCAL LENGTH. French feet. | FOCAL LENGTH. Metres. | REMARKS. |
|---|---|---|---|---|---|---|---|---|
| Observatory, Pulkova........ | A. Clark & Sons.... | 30 | .... | .... | .... | .... | .... | Constructing. |
| Observatory, Vienna......... | Grubb.............. | 27 | .... | .... | .... | .... | .... | Constructing. |
| McCormick, ——............ | A. Clark & Sons.... | 26¼ | .... | .... | 33 | .... | .... | |
| Observatory, Washington..... | A. Clark & Sons.... | 26 | .... | .... | 32·5 | .... | .... | Erected 1873. |
| Newall, Gateshead........... | Cooke.............. | 25 | .... | .... | 29 | .... | .... | Erected 1870. |
| Buckingham, London......... | Buckingham....... | 21 | .... | .... | .... | .... | .... | |
| University of Chicago......... | A. Clark & Sons.... | 18·5 | .... | .... | 23 | .... | .... | |
| Winnecke, Strasburg......... | Merz............... | .... | 18 | .... | .... | .... | .... | |
| Watson, Madison, Wis........ | A. Clark & Sons.... | 16 | .... | .... | .... | .... | .... | Erected 1880. |
| Warner Observatory, Rochester, N. Y. (Lewis Swift)... | A. Clark & Sons.... | 16 | .... | .... | .... | .... | .... | Constructing. |
| Pickering, Harvard College... | Merz............... | 15 | .... | .... | 23 | .... | .... | Erected 1843. |
| O. Struve, Pulkova.......... | Merz............... | 14·93 | .... | ... | 22·55 | .... | .... | Erected 1840. |
| Lord Lindsay, Dun Echt..... | Grubb.............. | 15 | .... | .... | 15 | .... | .... | |
| Huggins, Royal Society, near London................... | Grubb.............. | 15 | .... | .... | .... | .... | .... | |
| Houzeau, Brussels............ | Merz............... | 15 | .... | 0·038 | 6·4 | .... | .... | Erected 1878. |
| Downsede College, Bath...... | .........(?)......... | 14·5 | .... | .... | .... | .... | .... | Destroyed by fire in 1867. |
| Cooper, Markree Castle....... | .........(?)......... | 14 | .... | .... | 25 | .... | .... | |
| Oom, Lisbon................. | Merz............ .. | .... | 14 | .... | .... | .... | .... | |
| C. H. F. Peters, Clinton....... | Spencer & Eaton... | 13·5 | .... | .... | .... | .... | .... | |
| Boss, Albany.. ............. | Fitz....... ...... | 13 | .... | .... | 15 | .... | .... | |
| Rutherfurd, New York....... | Rutherfurd and Fitz | 13 | .... | .... | .... | .... | .... | Photographic. |
| Langley, Pittsburgh.......... | Fitz............... | 13 | .... | .... | .... | .... | .... | Refigured by A. Clark & Sons. |
| Mich. Univ., Ann Arbor....... | Fitz............... | 12·5 | .... | .... | 17 | .... | .... | Erected 1860. |
| Observatory, Greenwich...... | Merz, Simms....... | 12·7 | .... | .... | 16·6 | .... | .... | |
| Mitchell, Vassar College...... | Fitz, reworked by Clark........... | 12·5 | .... | .... | .... | .... | .... | |
| Pritchard, Oxford............ | Grubb.............. | 12·25 | .... | .... | .... | .... | .... | |
| Pritchett, Glasgow, U. S....... | A. Clark & Sons.... | 12·25 | .... | .... | 17 | .... | .... | Erected 1876. |
| Observatory, Paris........... | Secretan, Eichens... | .... | 12 | .... | .... | .... | 5 | |
| Observatory, Vienna.......... | A. Clark & Sons.... | 12 | .... | .... | .... | .... | .... | Made 1876. |
| Adams, Cambridge........... | Cauchoix........... | 12 | .... | .... | 20 | .... | .... | |
| Ball, Dublin................. | Cauchoix........... | 12 ? | 12 ? | .... | .... | .... | .... | |
| H. Draper, near New York... | A. Clark & Sons.... | 12 | . .. | .... | .... | .... | .... | |
| Main, Oxford................ | Cauchoix... ....... | 12 ? | 12 ? | .... | .... | .... | .... | |
| Pritchard, Oxford............ | Grubb.............. | 12 | .... | .... | .... | .... | .... | |
| Observatory, Paris........... | ..................... | .... | .... | 0·32 | .... | .... | .... | |
| Potsdam Observatory......... | Schröder........... | 11·7 | .... | 0·298 | .... | .... | 5·4 | |
| Campbell, Brooklyn, N. Y.... | Fitz, rew'd by Clark | 11⅞ | .... | .... | .... | .... | .... | |
| Stone, Cincinnati............. | Merz............... | 11.25 | .... | .... | 17 | .... | .... | |
| Von Bülow, Bothkamp....... | Schröder........... | .... | 11 | .... | .... | 16 | .... | |
| Observatory, Munich......... | Merz.............. | .... | 10·5 | .... | .... | 15 | .... | |
| Schjellerup, Copenhagen...... | Merz.............. | .... | 10·5 | .... | .... | 15 | .... | |
| Gould, Cordoba.. ........... | Fitz............... | 11·2 | .... | .... | .... | .... | .... | Photographic. |
| Van Vleck, Middletown, U. S. | A. Clark & Sons.... | 11 | .... | .... | ... | .... | .... | |
| Tempel, Florence............. | Amici.............. | .... | 11 | .... | .... | .... | .... | |
| H. Draper, near New York ... | A. Clark & Sons.... | 11 | .... | .... | .... | .... | .... | Photographic. |
| Rutherfurd, New York....... | Rutherfurd and Fitz | .... | 10·5 | .... | .... | .... | .... | Photographic. |
| D'Aguilar, Madrid............ | Merz.............. | .... | 10 | .... | .... | .... | .... | |
| Bredichin, Moscow........... | Merz.............. | .... | 10 | .... | .... | 16 | .... | |

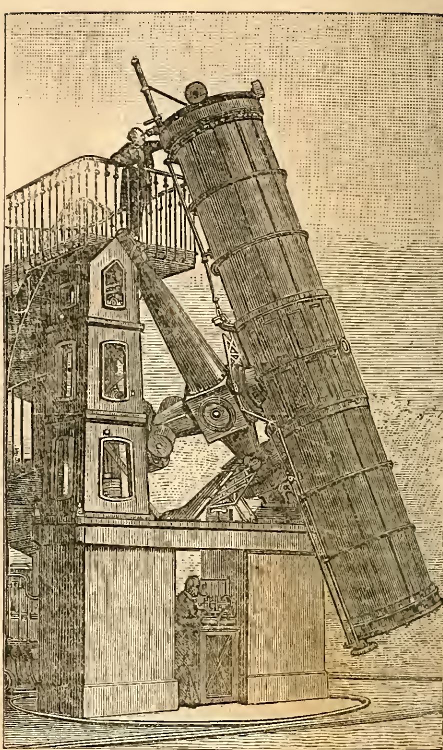
* Callenberger inches.

II. REFRACTORS (*Continued*).

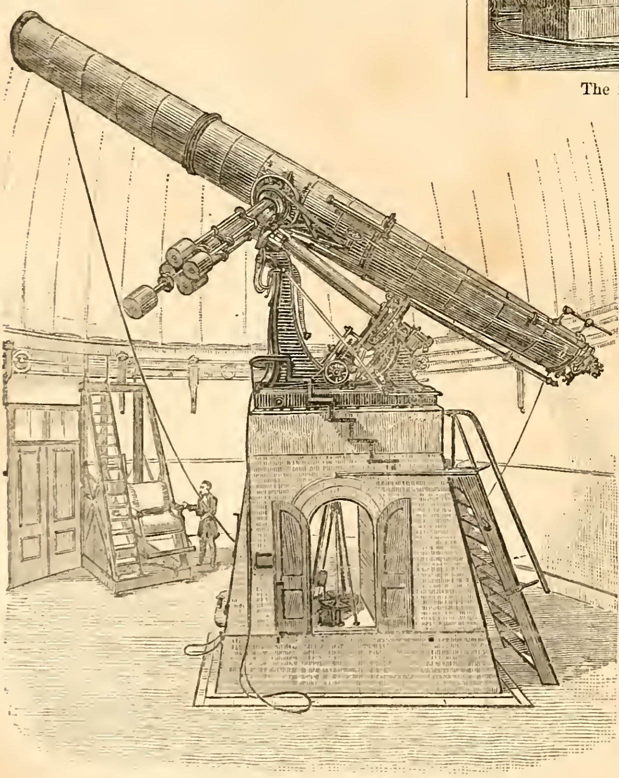
| OWNER OR DIRECTOR, AND OBSERVATORY. | Constructed by | APERTURE. English inches. | French inches. | Metres. | FOCAL LENGTH. English feet. | French feet. | Metres. | REMARKS. |
|---|---|---|---|---|---|---|---|---|
| Observatory Hamburg | Merz | 10 | ... | 0.255 | .... | .... | 3.1 | |
| U. S. Mil. Acad., West Point | Fitz, reworked by Clark | 10 | .... | .... | .... | .... | .... | |
| Stephan, Marseilles | Eichens | .... | .... | 0·25 | ... | .... | 3 | |
| Barclay, Leyton | Cooke | 10 | .... | .... | 12 | .... | .... | |
| Fletcher, Cumberland | .... | 10 | .... | .... | 12 | .... | .... | |
| ——, Dorpat | Fraunhofer | 9·62 | .... | .... | .... | 14 | .... | |
| Förster, Berlin | Merz | 9·62 | .... | .... | .... | 14 | .... | |
| Tacchini, Rome | Merz | 9·64 | .... | .... | .... | 14 | .... | |
| Observatory, Palermo | Merz | 9·62 | .... | .... | .... | 14 | .... | |
| Kowalski, Kazan | Merz | 9·62 | .... | .... | .... | 14 | .... | |
| Observatory, Washington | Merz | 9·62 | .... | .... | 15 | .... | .... | |
| Lefont, Calcutta | Steinheil | 9·62 | .... | .... | .... | .... | .... | |
| Pogson, Madras | Lerebours, Secretan | 9 | .... | .... | .... | .... | .... | |
| Buckingham, London | Secretan | 9 | .... | .... | .... | .... | .... | |
| Dartmouth College | A. Clark & Sons | 9·38 | .... | .... | 12 | .... | .... | |
| Grant, Glasgow | .... | 9 | .... | .... | .... | .... | .... | |
| Crossley, Halifax | Cooke | 9·33 | .... | .... | .... | .... | .... | |
| Edgecomb, Hartford | A. Clark & Sons | 9·4 | 9 | .... | .... | .... | .... | |
| Schultz, Upsala | Steinheil | .... | 9 | .... | .... | .... | .... | |
| Barneby, Worcester | Cooke | 9 | .... | .... | .... | .... | .... | |
| Lyman, Yale College | .... | 9 | .... | .... | .... | .... | .... | |
| Bruhns, Leipsic | Steinheil, Pistor | .... | 8 | .... | .... | 12 | .... | |
| Schiaparelli, Milan | Merz | 8·5 | 8 | .... | .... | .... | .... | |
| Potsdam Observatory | Grubb | 8 | .... | .... | .... | .... | .... | |
| Wilson, Rugby | A. Clark & Sons | 8·25 | .... | .... | .... | .... | .... | |
| Carleton College, Minn. | A. Clark & Sons | 8·25 | .... | .... | .... | .... | .... | |
| Haverford College | Fitz | 8·25 | .... | .... | .... | .... | .... | |
| Tempel, Florence | Amici | .... | 8 | .... | .... | .... | .... | |
| Erck, Ireland | A. Clark & Sons | 8 | .... | .... | .... | 6·25 | .... | |
| Ashe, Quebec | A. Clark & Sons | 8 | .... | .... | .... | 9 | .... | |
| Hartnup, Liverpool | Merz | 8 | .... | .... | 12 | .... | .... | |
| Nasmyth, Penshurst | Cooke | 8 | .... | .... | .... | .... | .... | |
| F. E. Seagrave, Providence | A. Clark & Sons | 8 | .... | .... | .... | .... | .... | |
| United States Naval Academy | A. Clark & Sons | 7·75 | .... | .... | .... | .... | .... | |
| Esty, Amherst College | A. Clark & Sons | 7·25 | .... | .... | 8·42 | .... | .... | |
| Bishop, London | Dollond | 7 | .... | .... | 11 | .... | .... | |
| Knott, —— | A. Clark & Sons | 7·33 | .... | .... | 9·4 | .... | .... | |
| Birt, London | .... | 7·5 | .... | .... | .... | .... | .... | |
| Leeson-Prince, —— | Tulley | 7 | .... | .... | 12 | .... | .... | |
| Russell, Sydney | Merz | 7 | .... | .... | 9·66 | .... | .... | |
| Stone, Oxford | Repsold | 7·5 | .... | .... | 10·5 | .... | .... | Heliometer. |
| Williams College, U. S. | A. Clark & Sons | 7½ | .... | .... | .... | .... | .... | |
| B. M. Fish, Hamburg, N. Y. | .... | 7⅛ | .... | .... | .... | .... | .... | |
| Observatory, Naples | Fraunhofer | .... | 7 | .... | .... | .... | .... | |
| O. Struve, Pulkova | Merz | .... | 7 | .... | .... | .... | .... | Heliometer. |
| College, Shelbyville, U. S. | Merz | .... | 7 | .... | .... | .... | .... | |
| Hansteen, Christiania | Merz | .... | 7 | .... | .... | .... | .... | |
| Observatory, Leyden | Merz | .... | 7 | .... | .... | .... | .... | |
| Dembowski, Florence | Merz | .... | 7 | .... | .... | .... | .... | |
| Russell, Sydney | Merz | .... | 7 | .... | .... | .... | .... | |
| Gyldén, Stockholm | Repsold | .... | 7 | .... | .... | .... | .... | |
| Bessel, Königsberg | Fraunhofer and Merz | .... | *70·2 l. | .. . | .... | *1,134 l. | .... | Heliometer. |
| ——, Cannstadt | Merz | .... | 6·5 | .... | .... | .... | .... | |
| S. Wilde, Montclair, N. J. | John Byrnes | 6·5 | .... | .... | 8·33 | .... | .... | |
| Wendell, Bates College, U. S. | A. Clark & Sons | 6·25 | .... | .... | .... | .... | .... | |
| Moore, Lynn, U. S. | A. Clark & Sons | 6·25 | .... | ... | .... | .... | .... | |
| Washington Univ'ty, St. Louis | Fitz | 6·25 | .... | .... | .... | .... | .... | |
| W. T. Gregg, Brooklyn | W. T. Gregg | 6·25 | .... | .... | .... | .... | .... | |
| Lockyer, London | .... | 6·25 | .... | .... | 8·5 | .... | .... | |
| Observatory, Mannheim | Steinheil | .... | 6 | .... | .... | 8 | .... | Now at Carlsruhe. |
| Burnham, Chicago | A. Clark & Sons | 6 | .... | .... | .... | .... | .... | |
| Lee, Hartwell | Tulley | 6 | .... | .... | .... | .... | .... | |
| Lehigh University, Penn. | A. Clark & Sons | 6 | .... | .... | .... | .... | .... | |
| Monckhoven, Genth | Cooke | 6 | .... | .... | 7·5 | .... | .... | |
| Lord Lindsay, Dun Echt | Cooke | 6 | .... | .... | 6 | .... | .... | |
| Pogson, Madras | Dollond | 6 ? | .... | .... | 5 | .... | .... | |
| Observatory, Vienna | Fraunhofer | .... | 6 | .... | .... | .... | .... | |
| V. Konkoly, O Gyalla | Merz | .... | 6 | .... | .... | 6 | .... | |
| Observatory, Warsaw | (?) | ? | 6 ? | 6 ? | .... | .... | .... | |
| Wolf, Zurich | Dollond | 6 | 6 ? | .... | .... | 8 | .... | Heliometer. |
| Schmidt, Athens | Dollond | 6 | 6 ? | .... | .... | .... | .... | Made 1876. |
| Schönfeld, Bonn | .... | .... | 6 | .... | .... | .... | .... | |
| University, Rochester, N. Y. | A. Clark & Sons | 6 | ... | .... | 7·50 | .... | .... | |
| E. L. Larkin, New Windsor, Ill. | A. Clark & Sons | 6 | .... | .... | .... | .... | .... | |
| Durham University | Ross | 5 | .... | .... | .... | .... | .... | |
| ——, Lucknow | Troughton | 5·5 | .... | .... | .... | .... | .... | |
| Observatory, Harvard College | A. Clark & Sons | 5·25 | .... | .... | .... | .... | .... | |
| Observatory, Brussels | (?) | .... | 5·91 | .... | .... | .... | .... | |
| Potsdam Observatory | Steinheil | .... | 5 | .... | .... | .... | .... | Heliometer. |
| Broun, Trevandrum | Dollond | 5 | .... | .... | 7·5 | .... | .... | |
| Lord Lindsay, Dun Echt | Repsold | .... | 4 | .... | .... | .... | .... | |
| Carrington, Red Hill | Simms | 4·5 | .... | .... | 4·3 | .... | .... | |

* Paris lines.

of silvered glass. Its mounting is somewhat different from the common one, and appears to have good points. (See engraving.) So far this telescope has not been successful, probably in consequence of an improper method of supporting the speculum during the process of grinding and polishing. A new reflector of 136 inches aperture was constructed and mounted in 1879 by Mr. A. A. Common of England. It has been used but a short time, and its excellence is highly spoken of by competent judges. If we may judge of it by its successful application in the observations of the faint satellites of Mars in 1879, it is by no means a more powerful instrument than the refracting telescope by which these bodies were originally discovered, viz., the 26-inch telescope of the United States naval observatory at Washington. (See engraving.) Many more observations were made by the latter telescope than by the former of the faint satellites of both Mars and Saturn. Mr. Common has obtained photographs of Jupiter's satellites with an exposure of $20^m$. Saturn and Mars can be photographed in $5^s$ to $8^s$. and Jupiter in $1^s$ to $2^s$. An exposure of $20^m$ on the nebula of Orion produced no result. Dr. Henry Draper photographed this nebula, Sept. 30, 1880, with an 11-inch Clark refractor, with an exposure of $50^m$. The accompanying table gives a list of the principal telescopes of the world. Reflectors of less than 13 inches aperture, and refractors of less than 6 inches, are not included unless for special reasons.



The four-foot Reflector at Paris.



The 26-inch Refractor at Washington.

**TENNIEL, John,** an English draughtsman, born in London in 1820. With little or no instruction, he won a prize in the cartoon competition for the decoration of Westminster Hall in 1845, and executed one of the frescoes. His best work is done with the pencil. In 1851 he joined the staff of "Punch," to which he has furnished many illustrations, as well as to "Once a Week." He has also illustrated "The Ingoldsby Legends," "Lalla Rookh," and other books.

**THOMPSON, A. Wordsworth,** an American painter, born in Baltimore in 1840. He went to Paris in 1861, where he studied under Charles Gleyre, Émile Lambinet, and Albert Pasini, and worked in the studio of the latter for one year. He exhibited "Moorlands of Au Fargi" at the Paris salon,

1865. Since 1868 he has made New York his place of residence. His works include "The Port of Menazzio, Lake Como," "Steamboat Landing at Menazzio," "Virginia in the Olden Times," "The Vesper Hour," "Annapolis in 1776," "Travelling in Corsica," "Gypsy Camp by the Sea," "View of Mount Etna," "Reminiscence of the Potomac," "Evening on the Moor," "Desolation," "A Picnic on the Rocks, Lake George," "Gathering Apples," "A Midsummer's Day on Long Island," "Pursuit of Knowledge under Difficulties," "By the Sea, Mentone," "A Review at Philadelphia in 1777," "The Road to the Saw Mill," "A May Day, Fifth Avenue, New York," and "An Autumn Day." He sent "On the Sands," "East Hampton," and "Virginia in the Olden Times" to the Philadelphia exhibition in 1876, and "The School House on the Hill" to the Paris exposition of 1878.

**THOMPSON. I. Cephas G.,** an American painter, born in Middleborough, Mass., in 1809. He was largely self-taught, and began his career as a portrait painter in Boston, Providence, New York, Philadelphia, and other eastern cities. He produced a series of portraits of American authors, some of which have been engraved. He went to Europe in 1852, resided for seven years in Rome, and in 1860 settled in New York. Among his best known works are "The Guardian Angel," "Prospero and Miranda," "St. Peter delivered from Prison," "Spring and Autumn," and his portraits of Bryant, Hawthorne, and others in Europe and America. **II. Jerome,** an American painter, brother of the preceding, born in Middleborough, Mass., in 1814. He began when very young as a sign painter near his native town, and afterward painted portraits for some years on Cape Cod. In 1831 he settled in New York. He spent two years (1852–'4) in Europe. Among his works, many of which have been engraved, are: "Reminiscences of Mount Mansfield," "The Old Oaken Bucket," "Home, Sweet Home," "Woodman, Spare that Tree," "Hiawatha's Homeward Journey with Minnehaha," "The Home of my Childhood," "Coming through the Rye," "The Land of Beulah," "The Voice of the Great Spirit," and "Dakota Cañon."—Their father, CEPHAS THOMPSON (1776–1858), was also a painter, and to some extent their instructor. He produced many portraits of the distinguished men of his time in the southern states.

**THYMOL** (thymic acid), an antiseptic acid having some analogy to carbolic acid. It exists in two isomeric forms, as a crystalline body and as a liquid. The crystalline form is procured from oil of thyme by prolonged refrigeration. The crystals melt at 111° F., and boil at 446° F.; and when once melted they remain fluid thereafter. The liquid acid is procured by treating the essence of thyme, in which it is associated with a hydrocarbon called thymene, with an aqueous solution of potash or soda, and separating it from the thymate thus formed by the addition of an acid. It is then purified by repeated washings, desiccation, and finally distillation. Thymol is very slightly soluble in water, but freely in alcohol, ether, and the fixed oils. It is seldom used except as an external application to wounds, ulcers, &c. For this purpose a solution of 1 part of the acid, 4 of alcohol, and 995 of water is generally employed. It may also be used in the form of an ointment made with 2 to 20 drops of the acid mixed with an ounce of lard. The pure acid is sometimes employed as a caustic.

**TIDEMAND, Adolph,** a Norwegian painter, born at Mandal in 1814, died in 1876. He studied first at the academy of Copenhagen, and afterward at Düsseldorf under Hildebrandt and Schadow. Tidemand was court painter in Norway, and a member of the academies of Berlin, Amsterdam, Copenhagen, and Stockholm. His specialties were landscapes and historic genre subjects. He displayed great power in arranging his groups, and in giving a characteristic expression to each face. He decorated the château of Oscarshall near Christiania. His works include "The Baptism of Christ," "The Distribution of the Sacrament to the Aged and Infirm, according to the Lutheran Form," "Single Combat in Ancient Times," "Village Funeral in Norway," "Farewell to Emigrants leaving for America," "Young Man Preaching," and "The Assembly of the Haugians" (Norwegian Methodists). The last is in the Düsseldorf gallery, and was reproduced several times by the artist.

**TIFFANY, Louis C.,** an American painter, born in New York in 1848. He studied under George Inness, and afterward under Léon Bailly in Paris. He has travelled extensively in France, Spain, and Africa, and has painted many pictures from his eastern sketches. His works include "A Dock Scene, Yonkers," "Fruit Vender under the Sea Wall at Nassau," "A Hunter's Dinner," "Street Scene in Tangiers," "Market Day outside the Wall, Tangiers," "Clouds on the Hudson," "Ceramic Wares," "A Study at Quimper, Brittany," "A Laborer's Rest," "Bouzarea, Algiers," and "The Old Round House, Bridgeport, Conn." To the water-color exhibitions he has sent "Venice," "Meditation," "A Merchant of the East," "A Shop in Switzerland," "An Old Shop at Algiers," "The Palace of the Pasha Ali ben Hassein at Algiers," and "The Cobblers of Boufarik." He sent to the Philadelphia exhibition of 1876 two water-colors, "Old and New Mosques at Cairo," and "A Street Scene in Cairo." To Paris, in 1878, he sent "Duane Street, New York," in oil, and "Market Day, Morlaix," and "The Cobblers of Boufarik," in water-color.

**TOOLE, John Lawrence,** an English comedian, born in London in 1832. He made his first appearance on the regular stage at the Ipswich Theatre Royal, and in 1852 played at the Queen's theatre, Dublin. He made his début on the London stage at the Haymarket theatre as

Simmons in the "Spitalfields Weaver," July, 1852, and afterward acted in the provinces for 18 months. His répertoire includes Sam Pepys in the "King's Rival;" Pierre in "Honor before Titles;" Fanfarronade in "Belphegor;" Autolycus in "Perdita, or the Royal Milkmaid;" Asmodeus in the play of that name; Mr. Spriggins in "Ici on parle Français;" Augustus de Rosherville in "The Willow Copse;" Bob Cratchit in "Christmas Carol;" William Kite in "Paper Wings;" Enoch Flicker in "A Story of '45;" Wapshot in "The Life of an Actress;" Caleb Plummer in Boucicault's dramatic version of "The Cricket on the Hearth" entitled "Dot;" the leading character in "The Area Belle;" Mr. Lysimachus Tootles in "My Wife's Maid;" Stephen Digges in the play of that name; Fathom in "The Hunchback;" Joe Bright in "Through Fire and Water;" Prudent in the "Fast Family;" Michael Garner in "Dearer than Life" (written for him by H. J. Byron); Jack Snipe in "Not Guilty;" and Dick Holland in "Uncle Dick's Darling." After a long and successful tour in the provinces, he reappeared on the London stage, adding to his list Paul Pry, Thespis in "Thespis, or the Gods Grown Old," Neefit in "Shilly-Shally," Mawworm in "The Hypocrite," and Hammond Coote in "Wig and Gown." In 1875 he visited the United States, and represented his best known characters in the principal cities. On returning to London he undertook the management of the Folly theatre, opening in Chawles in Mr. Byron's comic drama, "A Fool and his Money," Nov. 17, 1879.

**TOURGEE, Albion Winegar,** an American author, born in Williamsfield, O., May 2, 1838. He is the son of a farmer of Huguenot descent, and received his early education at Kingsville academy. In 1859 he entered the university of Rochester, N. Y., in an advanced class, but in 1861 left college and enlisted as a private in the 27th New York volunteers. He was wounded at Bull Run, and was laid up for a year, during which time he studied law at Ashtabula, O. He returned to the army in 1862 as a lieutenant, was again wounded in the battle of Perryville, and for four months was a prisoner in the hands of the confederates. After the war he settled near Greensboro, N. C., where he engaged in agriculture and the practice of law. In 1866–'7 he published at Greensboro the "Union Register" newspaper. He opposed the plan of reconstruction which was adopted, favoring that of Thaddeus Stevens, which proposed to establish territorial governments in the revolted states; but after the passage of the reconstruction acts he was elected, in the autumn of 1867, to represent Guilford county in the constitutional convention. A large part of the constitution adopted was drawn up by him. In February, 1868, the convention appointed him one of three commissioners to draw up a code of practice and procedure, and revise the laws of the state so as to adapt them to the new order of things. His associates were the Hon. W. B. Rodman and the Hon. V. C. Barringer. In April, 1868, he was elected judge of the superior court for the 7th judicial district of the state, his term expiring in 1874. In August, 1875, he was again elected, as a republican, to represent Guilford county in a constitutional convention, and in February, 1876, was appointed pension agent for North Carolina. He has been prominent as a political speaker in every canvass since 1865. The district in which he presided as judge included the counties where the "Ku-kluk Klan" was at its worst, and several raids were planned for his capture, but he succeeded in escaping them. Judge Tourgee's legal publications are: "The North Carolina Form Book" (1869); "The North Carolina Code, with Notes and Decisions" (1878); "A Digest of Cited Cases" (1879); and "Statutory Decisions of the North Carolina Reports" (1879). In fiction he has published, besides numerous short stories, "Toinette" (New York, 1874); "Figs and Thistles" (1879); "A Fool's Errand, by One of the Fools" (1879; new ed., including "The Invisible Empire," 1880); and "Bricks without Straw" (1880). The "Fool's Errand," though in the form of a romance, is understood to be a nearly literal account of his experiences as a northern man attempting to establish a home in the south.

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